

A systemic design application for resources management in urban green spaces

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**Book of Abstracts**

# **World Forum on Urban Forests**

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# **Book of abstracts**

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Compiled by: **Lucia Cherubini and Giovanna Rullo** – Consiglio Nazionale delle Ricerche (CNR), Istituto di Ricerca sugli Ecosistemi Terrestri (IRET)

# **ORAL PRESENTATIONS**

# **Parallel Session 1 - The Past and Green Cities**

## PS 1.1: Green Cities – *Chaired by Alan Simson*

### **Ljubljana – a City in the forest**

*Andrej Verlič, Nejc Praznik, Jurij Kobe*

### **New International Collaborative Project Green Cities for Papua**

*Paulus Mandibondibo, John Parker*

### **Project "Kaolack green city"**

*Momath Diankha*

### **MODENA: from green to forest city**

*Andrea Di Paolo, Simona Arletti*

### **Urban Forestry in changing Environment: A Case Study of National Capital Region, Delhi, India**

*Shashi Bhushan*

### **Lahore: The City of Gardens**

*Amna Rafi Chaudhry*

### **Improving the urban forest approach in Limoges, France**

*Laurent Bray*





## **Ljubljana – a City in the forest**

*Andrej Verlič<sup>\*1</sup>, Nejc Praznik<sup>1</sup>, Jurij Kobe<sup>2</sup>*

*1. Snaga, d.o.o.*

*2. The City of Ljubljana*

Ljubljana. Population (2017) 288,919. Total land area 275 square kilometres. Total green space 201.3 square kilometres. Green space per person 560 square metres. To live in a forest was until recently considered somewhat strange, if not savage and undesired. In most places around the World, people (get to choose to) either live in an urban, built up area, or in a countryside, maybe even in a forest. Those citizens living in a city have increasingly stated missing the non-built environment, even wild places, such as forest. Some of them are lucky to live in cities that have protected and promoted trees and forests within and around them. Reasons for keeping and promoting tree covered areas were different, but their efforts are getting backed up by increasing scientific evidence on urban forests, being it for the public health or environmental benefits. Ljubljana is such a city. The forest – excluding individual trees – covers almost a half of the municipality. One of the most precious protected areas lies in the City center. It is composed of a natural forest and the biggest park in the City – the Landscape park Tivoli, Rožnik and Šišenski hrib. The park was first protected in 1984 and is being actively managed by public company Snaga, since 2018.

**Keywords:** urban forest, urban protected area, European Green Capital, city park

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## **New International Collaborative Project Green Cities for Papua**

*Paulus Mandibondibo\*, John Parker*

*Ottow Geissler University of Papua and Green Cities for Papua & Transport for London and The London Tree Officers Association, UK*

This joint presentation from Paulus Mandibondibo (University of Ottow Geissler, Papua) and John Parker (Transport for London and the London Tree Officers Association, UK) will describe the new international collaborative project Green cities for Papua. It will outline the traditional relationship between people and trees in Papua, the current state of urban forestry in the communities of Jayapura and Biak and will explain the motivation for working to change the nature of Papuan cities through urban forestry. Whilst there are many trees in Jayapura and Biak, these urban forests are not currently being managed to maximise their full potential to deliver environmental, economic and social benefits to citizens and visitors. This presentation will describe how through community engagement, political support, increased awareness, education and improved standards the ecosystem services delivered by the urban forest can be employed to address problems such as stormwater management and the urban heat island effect. It will also look at the potential to combine urban forestry with the wider aspiration of Papua to become a world leader in ecotourism; bringing ecotourism into the cities. This project is an example of international – and intercontinental – collaboration, highlighted by the fact that the authors met via the Trees for the Cities D-Group. It demonstrates the value of exchanging ideas and experiences between nations and promoting the importance of communication to achieve a common goal; in this case to help create greener, healthier and happier cities in Papua through urban forestry.

**Keywords:** Papua, urban forestry, international collaboration

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## Project "Kaolack green city"

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The city of Kaolack erected in joint municipality since 1917, is located in Senegal. With a surface area of 14,514 ha, the town is largely composed of salty land. Thus with our program "Kaolack green city" young people and especially women have been able to reforest their districts using the peanut shell. Fruit and shade plants have allowed a better improvement of food security among the population and also a more pleasant living environment. Our approach in this program is awaring young people and women with exchanges, meetings, focus discussions that we organize. This made it possible to form a partnership with the association "And Defar Dialegne Est"; "The Solidarity Youth Association for the Development of Darou Salam Diamagene". Among the seventeen (17) neighborhoods in the commune, six (6) benefited from our actions (Dialegne, Medina, Léona, Ngane, Thioffac, Kasnack). The district of Dialègne threatened by the tannes (salty and floodable lands) found the greenery through the maintenance of shade trees. In Léona, in front of the health service, which is a resting place for patients and companions of the Elhadji Ibrahima Niass Regional Hospital, has become welcoming because of the greenery. Our ambition is to intervene in the seventeen districts of the municipality. In this initiative, we have the support of the State of Senegal through the Water and Forest Service, local communities through the Kaolack Town Hall but their resources are very limited. Through our participation in the forum, we could expose our project, show our achievements and also find partners to complete this wonderful work started in the town of Kaolack. This example can be realized in other African cities facing the same problem of soil and water salinization.

**Keywords:** Kaolack, salinization, reforest, plants, soil

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## MODENA from green to forest city

*Andrea Di Paolo<sup>\*1</sup> Simona Arletti<sup>2</sup>*

*1. STUDIO ANDREA DI PAOLO Dottore Agronomo*

*2. President Italian Association "Healthy Cities" OMS*

Modena (181,000 inhabitants) is one of the Italian cities with the largest number of trees and green areas. The public green system, organized in four macro typologies, consists of about 10 million m<sup>2</sup>, of which 58% of parks and green recreation areas, 30% of areas with natural evolution (urban forestation), 8% of roadside green and 4% of protected areas. The arboreal heritage is about 200,000 trees of which 53% of urban forestation, 33% of parks and green recreation areas and 14% of roadside green. In addition to these data, there is the private green particularly widespread in the city that creates an extensive ecological network and a green system in a continuous way throughout the urban area. The urban forestation areas are mainly concentrated along the main road and railway infrastructures. It is foreseen that, in the next three years, the realization of additional 180,000 m<sup>2</sup> of urban forests, with the planting of 16,000 plants alongside the ring road. Many other urban forests are being identified in the new urban plan that is being elaborated. Also there are studies and actions aimed at the implementation of urban regeneration hand-in-hand with nature. Urban forests, like "carbon absorption deposits", in our cities fulfil the difficult task of countering climate change, increasing resilience and adaptability; but also improve the environment (reducing pollution), heat island, energy consumption, etc. making cities safer, more pleasant and healthier to live. The experimental data collected and the analyses carried out in terms of environmental and microclimatic improvement, thanks to the enhancement of the green infrastructure, are enlightening and will be available by November 2018. That is why Modena could become a national leader in its commitment to act on urban forestation matters and, in general, the sustainability of the city.

**Key words:** Urban forests, sustainability, green system, resilience, adaptability

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# Urban Forestry in changing Environment: A Case Study of National Capital Region, Delhi, India

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Urban forestry has a significant role in ameliorating urban habitats and improving quality of life. It contributes to enhance environmental quality and sustainable development in urban areas by maintaining urban biodiversity, reduction in noise pollution, prevention of soil erosion, improving groundwater condition and level of oxygen. In a faster pace of urbanization, urban green spaces in India are under pressure due to ever increasing of population, unplanned settlements, pollution, lacking of infrastructure facilities and illegal encroachment. My study monitors the growth of forest area in last four decades and emphasizes the role of forestry on socio-economic condition in changing environment of national capital region of Delhi, India. This research provides an opportunity to understand the spatial pattern and dynamics of urban forest landscape that would not only help in better planning and governance but would also maintain and uphold the sustainable management of a forest area. The present study demonstrates the use of remote sensing and GIS techniques to highlight the extent of forest cover in National Capital Region (NCR) at a detailed level. A spatial modeling approach using vegetation indices, Leaf Area Index, local pollution concentration data and health data was applied. Census data for different years & data on Forest Cover of State forest Report has been used in the discussion. Contemporary greening practices and continuous effort in this direction through contribution of various government departments, educational institutions, municipal bodies and local residents, results the immense growth of total forest area in last four decades. In changing environmental scenario, planning through conservation of biodiversity hot spots, linear plantation, integrated and systematic management, measure of legal control and alternative resource base should be stressed upon for sustainable urban development.

**Keywords:** Urban biodiversity, environmental scenario, sustainable urban development, greening practices, systematic management

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## Lahore- The City of Gardens

*Amna Rafi Chaudhry*  
*Landscape Architect, Citizen of Lahore*

Lahore is known as a ‘City of Gardens’ due to examples dating from the Mughal Era, British intervention and continuing support from its citizen in the form of movements such as ‘Darakht Bachao, Lahore Bachao’ (Save trees, Save Lahore). Shalimar Garden, Shahdara Bagh, Baghe Jinnah, Model Town Park, Iqbal Park and Safari Park are some examples of the celebrated green spaces. In addition to these wide green belts with thickly shaded trees act as a relief to the high temperatures and aid in reducing pollution. Also the urban footprint of Lahore is such that majority owners of residential plots prefer to contribute 5-30% of plot size to a private green space mostly with local species of plants and trees. All these measures cumulatively have maintained Lahore as a refreshing green city where people constantly frequent at green spaces for lively events, festival or an evening walk. These greens act as a source of social cohesion but two recent changes are overturning the image of the city. One is the Lahore Metro, a transport corridor solely designed on a mega scale for public transport in the city. Lahore, where green belts form the key foundation of the city is pierced with overhead bridges, underpasses and thick iron fences demarcating the lines of the metro. Secondly due to strict planning regulations on high-rise buildings the city continues to expand horizontally. On one hand this horizontal expansion controls the city from turning into a concrete jungle but the usurping of surrounding agricultural land for urban expansion is a concern. In light of how the rich green infrastructure has served as fundamental basis of public involvement, a healthier and happy city this research will study strategies which can be implemented to counter the adverse effects of the Lahore Metro and Urban Expansion of Lahore.

**Keywords:** Parks, Green belts, plots, metro, urban expansion

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## **Improving the urban forest approach in Limoges, France**

*Laurent Bray\**  
*Green Spaces Department*

Maintaining biodiversity and managing the urban forests for the inhabitants of the City of Limoges, France, is a major objective of the Green Spaces Department. The city of Limoges has 135,000 inhabitants and is the 27<sup>th</sup> most populated French city. The 200 gardeners manage 1,500 ha of green spaces (parks, gardens and natural woods) including a botanic garden accredited by the French-speaking botanic gardens association. Because the Limoges city health citizen charter promotes public health and protection of the environment, trees play a key role in the city. The city cares for 52,000 trees in the public green spaces, as well as 220 ha of public woodlands. A diversification strategy has been launched over the last several years. In order to ensure a future healthy urban forest, we have identified several challenges that must be addressed including:

- 1) Public perception on the value of trees.
- 2) Managing an aging forest where many trees are needing to be replaced
- 3) Taking into account the climate evolution
- 3) Improving tree species diversity using native ones on all our green spaces
- 4) Prioritizing the public resources needed.

For example, in many of the managed historical gardens, all trees were planted during the 19<sup>th</sup> century with little species diversification. Therefore, trees must be replaced at the same time. We are changing the precedent by replacing them with a more diverse selection, increasing native species, and taking into account the edaphic conditions and possible pollen allergies. These changes in management result in temporary visible canopy gaps that require improved communication with the city staff as well as with the public. These challenges are anticipated to increase in the future, especially because of the climate evolution, and we will present our strategic approach to overcome obstacles for the ultimate improvement of the city's green corridors.



## PS 1.2: Changing People and Benefits – *Chaired by Thomas Randrup*

### **Assessing the Outcomes and Impacts of a Federal Urban & Community Forestry Grant Program in the United States**

*William G. Hubbard, J. Holly Campbell*

### **Sustainable Development in the Peri-Urban Green Area by Local Community: A Case Study of Kung Bangkrachao Community, Thailand**

*Prassaporn Siriwichai*

### **Participatory Inventory Of Urban Forest: Case Study On Community Involvement By The Volunteer Program “Voluntárboles”**

*Ana Paula Duarte, Andrés Baietto, Gustavo Daniluk, Guillermo Moras, Andrés Hirigoyen, Mathias Rodríguez*

### **Policy and legal issues relating to urban forestry in India with particular reference to Meghalaya**

*Cavouright Phanto Marak, Ranjit Singh Gill*

### **Policy for urban green space management in Democratic People’s Republic of Korea**

*Mi Sun Park*

### **Relations between perceived stress-relief and safety and green infrastructure features in a historical urban landscape**

*Thomas Campagnaro, Riccardo Da Re, Daniel Vecchiato, Arne Arnberger, Riccardo Celegato, Riccardo Rizzetto, Paolo Semenzato, Tommaso Sitzia, Dina Cattaneo*

# **Assessing the Outcomes and Impacts of a Federal Urban & Community Forestry Grant Program in the United States**

*William G. Hubbard\*, J. Holly Campbell  
Southern Regional Extension Forestry the University of Georgia*

Since 1994, the National Urban and Community Forestry Advisory Council (NUCFAC), to the USDA Secretary of Agriculture, has annually provided close to \$1 million in grants that meet the goals and objectives of updated National Urban and Community Forestry Action Plans (Plan) (<https://urbanforestplan.org/>). The Plan, developed in conjunction with thousands of stakeholders, provides specific goals, actions, and recommendations for improving the status of urban and community forestry for the US and its territories. The purpose of the Plan and the grant program is to expand awareness of the benefits that urban forests provide communities, including benefits such as natural infrastructure, economic sustainability, and improvements in environmental quality. Today, every dollar provided by the US government in grant programs such as this should be viewed as an investment with quantifiable returns. To demonstrate the value of NUCFAC funded grants, the Forest Service supported an online and phone interview assessment of the impact of these grants. Twenty six grants, awarded during years 2010-2015, were assessed for 8 impact indicators: 1) How outputs are utilized by stakeholders; 2) Estimated number of individuals reached through the project; 3) Project promotion efforts; 4) Whether the project was replicated; 5) If the project was used in the establishment of a business, policy, process, or other; 6) Continued work on the project following grant closure; 7) Additional funding beyond the grant period; and 8) Unexpected project outcomes. The projects assessed in this analysis (current and completed) were awarded a total \$4,733,330 in federal dollars, which were supplemented with \$5,538,459 in matching funds and \$13,016,155 in additional awarded funding, totaling \$18,554,614. This equates to a return of \$3.92 for every \$1 of federal funds invested. This presentation provides a summary of the survey procedure and key results and uses of the research findings.

**Keywords:** evaluation, return-on-investment, grant-funding, economic impact, program-impact

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# **Sustainable Development in the Peri-Urban Green Area by Local Community: A Case Study of Kung Bangkrachao Community, Thailand.**

*Prapassorn Siriwichai  
Chulalongkorn University*

“Kung Bangkrachao” is the largest peri-urban green area in Thailand with an area up to 18.9 square kilometres, located in the fringe of the capital city, Bangkok. The “Urban Oasis”, as it was once entitled by the TIME magazine in 2006, or the “Green Lung”, as it is referred by Thai people, Kung Bangkrachao has a crucial ecological role in the benefiting the Bangkok metropolitan by producing almost 6 million tons oxygen per day, preventing soil erosion and toxic dust flew to the central business district (CBD), keeping the ambient cool and also controlling the saline water and flooding in the area. In addition to ecological benefits, it also provides a lively viable neighbourhood for social activities such as local agricultural products market, ecotourism and leisure businesses. Despite the practical significance of the area, population growth and urban sprawl, expansion of industrial sites and also climate change have been affecting Kung Bangkrachao in terms of depletion of trees and decreasing the area biodiversity and size. In order to accomplish Sustainable Development Goals (SDGs), there are multilevel schemes planned by academia, governmental institutes, NGOs and private sectors assisting to preserve Kung Bangkrachao area but still far behind the threats approaching it. Thus the “Kung Bangkrachao Community” has been pursuing the goal to preserve this unique place and pass this treasure to the next generations by constructing a local organisation as a bottom-up developments scheme. This study reveals the current situations of the area and demonstrates how a local community organisation tries to achieve the targets of a sustainable development in Kung Bangkrachao peri-urban green area which can be considered as a model for preserving other area.

**Keywords:** Peri-Urban green area, local community, Sustainable Development, Kung Bangkrachao

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## **Participatory Inventory Of Urban Forest: Case Study On Community Involvement By The Volunteer Program “Voluntárboles”**

*Ana Paula Duarte\*, Andrés Baietto, Gustavo Daniluk, Guillermo Moras, Andrés Hirigoyen, Mathias Rodríguez*

*Forest Department, Faculty of Agronomy, Universidad de la República Uruguay*

Urban forests must be planned and managed in an efficient and sustainable way, it being essential to know the trees that constitute it, their dasometric characteristics, where they are located and in what phytosanitary conditions they are. An efficient tool is the inventory, where each tree can be registered and documented, guaranteeing complete information, easily accessible and updatable. Because it is a detailed and time-demanding activity, many municipalities do not have enough budget to carry out a complete and quality tree inventory, nor the capacity to keep it updated. An alternative to solve this problem is incentive of community participation by volunteer programs. This inventory is called participatory inventory. The data collected by volunteers have been presented as a viable option, mainly if the information to be collected is simple. On October 24, 2017 the Volunteer Program "Voluntárboles" was founded by the Forest Department, and in association with the Botanical Garden of Montevideo and the NGO "Asociación de Amigos del Jardín Botánico y otros Espacios Verdes" was started the participatory inventory of the Botanical Garden. The program includes the volunteer's training and monitoring, guidelines for photographic records, measurement of the circumference, geographic positioning, and analysis of phytosanitary condition. After training, volunteers go to the place with a GPS, tape measure, guidelines and a smartphone to register trees on an online platform. In 2 months, 15 volunteers joined, who registered 100% of the trees and the final result was presented. This program provided the Botanical Garden an efficient and easily upgraded management tool; to the volunteers, knowledge in botany, dendrology, and phytopathology; to the university, the development of new research fields and extension; and to the community, the socialization of information, generating awareness and empowerment of the public space.

**Keywords:** urban forestry, dasometry, volunteer program, urban parks, Montevideo

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## **Policy and legal issues relating to urban forestry in India with particular reference to Meghalaya**

*Cavouright Phanto Marak, Ranjit Singh Gill\*,  
Forest & Environment Department, Government of Meghalaya*

Urbanization has taken India by storm, triggering fresh challenges and policy reforms. This paper focuses on the unique situation in a specific part of India. Meghalaya is a hilly state in India's north-east that is home to the Garo, Khasi and Jaintia communities residing in different parts of the state. In each region the members of the respective community own a major chunk of the land and forests. The Sixth Schedule of the Constitution of India provides for Autonomous District Councils (ADCs) to look after the administration in the respective area of jurisdiction. The ADCs have the power to constitute town committees for the administration of urban areas in their domain. The State Government, meanwhile, has power to constitute municipalities to administer the delineated areas that fall under their jurisdiction. In areas where there are neither municipalities nor town committees, the urban administration is carried out by traditional bodies practising customary law. Thus urban governance in Meghalaya is frequently under the charge of different and mutually exclusive administrative bodies that confine to their domain. Where does urban forestry lie amid the multiplicity of administrative bodies? This is the core of the urban forestry conundrum in Meghalaya. The Government of India launched the Smart City initiative in 2015 envisaging the creation of a hundred Smart Cities throughout the country. Urban greenery is a vital necessity for India's choking towns and cities. The multiplicity of bodies in Meghalaya poses a challenge to take up such urban initiatives. A unified structure is crucial to implement urban forestry which cannot be straitjacketed to be coterminous with narrow administrative boundaries. Until the issue of multiple jurisdictional authorities is resolved, the State Forest Department in Meghalaya provides the best platform for designing and implementing urban forestry.

**Keywords:** Smart City, Autonomous District Council, Meghalaya, customary law

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# Policy for urban green space management in Democratic People's Republic of Korea

*Mi Sun Park\**

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Democratic People's Republic of Korea has conducted reforestation and afforestation activities against deforestation and forest degradation. After the Act of Urban Greening was established in 1999, urban greening policies have been emphasized for two decades in DPRK. Urban green spaces provide ecosystem services as the benefits people obtain from ecosystems. This study aims to analyze changes of DPRK policy for urban green space management over two decades. For the analysis, documents such as plans, regulations and policy reports on urban greening and urban planning from 1999 to 2015 were collected and analyzed. Although there is a barrier to have access to information on DPRK, Rodong Shinmun as an official newspaper by DPRK Workers Party is a significant resource including data on DPRK. In particular, Rodong Shinmun represent intentionally governmental policies. The articles including the word 'forest' in the title of articles of Rodong Shinmun were selected for media content analysis from 1999 to 2015. Media frames on urban green space management were figured out. In particular, instructions by Kim Jong-Un were analyzed. Acts about urban green space management including Act on Urban Management, Act on Urban Planning and Act on Urban Greening were analyzed. DPRK policy approaches to urban green spaces were analyzed using the concept of ecosystem services. The research findings do contribute to a better understanding of institutional and legal systems for urban green space management in DPRK, focusing on ecosystem services.

**Keywords:** Urban Green Space, DPRK, Sustainability, Ecosystem Services

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## **Relations between perceived stress-relief and safety and green infrastructure features in a historical urban landscape**

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Urban green spaces are increasingly important for citizen wellbeing. To maximize their benefits to quality of life a deep knowledge of citizens' perception and use of urban open spaces is crucial in the planning and design of green infrastructures. Urban dwellers can have various and contrasting perceptions of these spaces, depending on their personal preferences, psychological state, perceived safety and security. The type of green space and its specific features result in different types of ecosystem services and can be valued differently. Different tools and approaches should be employed to obtain a broad picture of citizens needs in terms of green spaces within the city. In this paper we present a project, carried out by a multi-disciplinary team represented by urban foresters, statisticians, and economists, engaging with citizens of Padova (Northern Italy). This study investigates the preferences of 295 on-site visitors in a linear park in a historic context in the city, often surrounded by waterways and Renaissance walls and buildings. In 2017, face-to-face interviews of citizens were performed. Questionnaires were administered, enabling to collect information of socio-demographic data, and regarding use, access, and frequency of visits by the interviewed. Furthermore, choice sets, based on modified images of different green space scenarios, were used to test users preferences connected to both stress relief and safety perception. Conjoint Analysis, widely used and appreciated in market research, was employed. Our aim was to find out if the citizens' preferences are related to their self-reported level of stress and consequently to identify the structural features of the green spaces most effective in reducing stress, and in increasing people's feeling of safety.

**Keywords:** Green infrastructure; Visitor perception; Urban planning; Discrete choice experiment

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## PS 1.3: Changing Spaces and Places – *Chaired by Pedro Calaza-Martínez*

### **Is urban spatial development on the right track? Comparing strategies and trends in the European Union**

*Chiara Cortinovis, Dagmar Haase, Bruno Zanon, Davide Geneletti*

### **A systematic review of urban forest and green space related research in the Mediterranean**

*Silvija Krajter Ostoić, Fabio Salbitano, Simone Borelli, Andrej Verlič*

### **The fourth nature of the contemporary city: from Rio de Janeiro to Seattle**

*Barbara Boifava*

### **Make No Little Plans: Achieving Burnham's Livable City Vision in Chicago and the Philippines**

*Al Zelaya, Carlo Benitez Gomez, Taykhoom Saifuddin Biviji*

### **Urban Forest Management For Better Cities: Case Studies And Trends From The Board Of Directors Of Public Green Spaces In Italy**

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### **Wild urban woodlands: inappropriate occupier of abandoned spaces?**

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# Is urban spatial development on the right track? Comparing strategies and trends in the European Union

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Spatial development is a crucial issue for urban sustainability. Spatial strategies to direct planning toward sustainable urban development are progressively gaining international consensus through initiatives like the UN New Urban Agenda; however, their effectiveness and actual applicability across the variety of world cities is still contested. In this process, an interesting test-bed is represented by the European Union (EU), where common spatial strategies have been discussed since 1993. The aim of the research is to compare spatial strategies for sustainable urban development promoted by EU policies and on-the-ground development trends of EU cities. Six main strategies were identified in the EU urban policies of the last 25 years, namely compact city, urban regeneration, functional mix, no land take, green city, and high density. For each strategy, a set of indicators were selected and applied to analyse the combined changes in land use and population from 2006 to 2012 in 175 EU cities. The results show that compactness and functional mix increased in most cities, but only two cities achieved no land take. Urban regeneration was more intense in Northern and Western cities, while Southern cities present the highest increase in green spaces. Growing cities increased in density, but their inefficient expansion generated abandonment of urbanized areas and fragmentation of agricultural land. Shrinking cities continued in the already-noted paradox of contemporary population loss and expansion. The results highlight potential conflicts and trade-offs that may arise in the implementation of the strategies, as well as non-linear behavior, hence the need for monitoring multiple spatial features of urban systems to ensure a truly-sustainable spatial development. The adopted indicators represent a first monitoring scheme that exploits open data available EU-wide. Similar analyses can stimulate comparison, exchange, and cooperation among cities, thus supporting an effective mainstreaming of non-prescriptive strategies agreed at the international level.

**Keywords:** EU cities, urban spatial development, EU spatial strategies, indicators, land use transitions

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# **A systematic review of urban forest and green space related research in the Mediterranean**

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The Mediterranean region is one of the most populated and urbanised areas on the planet facing many challenges. This leads to pressures on natural resources altogether influencing the quality of life of urban residents. Urban forests and green space with their multiple benefits can help addressing these challenges and hence improving the quality of life. Implementation of nature-based solutions depends on both empirical knowledge as well as scientific evidence. The purpose of the contribution is to give a Scopus-based systematic review of the urban forest(ry) related research in the Mediterranean covering a 20-year period since it is clearly missing. We analysed overall distribution of papers over time and per country as well as prevailing research themes, research methods, approaches and study locations. Results showed uneven distribution of research papers across the Mediterranean. Papers from North Mediterranean countries prevail with Italy, Turkey and Spain being top three countries based on number of contributions. On the other hand, papers from South or East Mediterranean countries are scarce to non-existent (with the exception of Turkey and Greece). Some topics are more relevant for some countries. For example, role of green space for abating pollution is most frequent topic in Italy, while the role of green space for human health is most relevant in Spain. On the other hand, sociocultural aspects of urban forests and green space are important topic in Turkey, and somewhat marginal in Italy and Spain. One the most surprising results is weak focus on climate change given the fact that the Mediterranean is a climate change hot spot.

**Keywords:** Mediterranean, research, review, urban forest and green space

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## **The fourth nature of the contemporary city: from Rio de Janeiro to Seattle**

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This submission is about the concept of the 'fourth nature', intended as the nature of the city, and it is based on the experience of two important landscape architects: Roberto Burle Marx and Lawrence Halprin, respectively in Rio de Janeiro and Seattle, Washington. The proposed analysis centers on a renewed relationship between the city and nature starting with the evaluation of an effective natural scale of the urban project; one that presents a specific model in the development of the contemporary city. With due reference to Le Corbusier's Ville verte, comparisons with the work of a great master like Burle Marx, and the work of Halprin that followed a few years later, suggest an entirely new project for public space intended as the transposition of an original landscape and of a native ecology, as with the forest of Tijuca in Rio de Janeiro and the old growth forest up on First Hill in Seattle. To analyze the specificity of these projects means to single out the founding components of a project design in which the urban scene becomes a field of experimentation of strongly innovative approaches that are capable of evoking natural processes, while validating formal and ideological reflections of a profound ecological significance. Through the investigation of these two exemplary case-studies, my proposal intends to explore the founding contributions that went into defining 20th century urban landscape. In particular, Roberto Burle Marx's Aterro do Flamengo in Rio de Janeiro at the beginning of the 1960's, and Lawrence Halprin's Free Way Park in Seattle one decade later both introduce unprecedented categories of places that become episodes of exceptional relevance for the originality of their formation, the particular amplification of the effects of nature, and the value they hold in the culture of the landscape project in Brazil and in the United States.

**Key words:** Cityscape, forest, ecology, model, Park System

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# Make No Little Plans: Achieving Burnham's Livable City Vision in Chicago and the Philippines

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Daniel Burnham was an American architect and urban designer famous for developing the first comprehensive urban plans for cities including Chicago, Washington D.C., Manila and Baguio in the Philippines. Although urban forestry was not a field of practice at the turn of the 20th century, Burnham's vision of creating livable cities included preserving green and open spaces and providing access for all citizens to parks to help people cope with urban stresses. A century later achieving Burnham's vision is still an ongoing endeavor in the Philippines and Chicago – but advances in urban forestry tools and technologies have enabled planners, managers and citizens to better understand and optimize the environmental services and values of urban trees and forests for the good of people. Innovative and accessible urban forest assessment applications such as the i-Tree Suite of tools, developed by the US Forest Service, have allowed managers to understand the relationship of urban forest structure and function including pollution removal, hydrology effects, carbon sequestration, and human health impacts. Managers can now apply science-based tools to help plan, preserve and prioritize urban natural resources – and protect human populations at risk. This tale of two cities on opposite sides of the planet will highlight how innovators in Chicago and the Philippines are applying urban forest tools, networking and communication strategies to achieve Burnham's vision of livable, sustainable and resilient cities. Puerto Princesa is a rapidly growing Philippine city dealing with loss of trees and forests to development, increased tourism pressures, and administration demands to expand economic opportunities. Chicago's west side inner-city neighborhoods have numerous socio-economic challenges along with tree canopy decline and a subsequent loss of benefits provided to residents. Creative urban forestry tools and strategies are being applied to reconnect citizens with their urban natural resources and improve livability for both cities.

**Keywords:** Livability, resilience, equity, technology, community

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# Urban Forest Management For Better Cities: Case Studies And Trends From The Board Of Directors Of Public Green Spaces In Italy

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The increasing responsibility of cities in the contemporary societies as well as the dramatic changes occurred in lifestyles, land use and, first among all, climate, call for innovative approaches in urban planning, design and management so to face the growing complexity of cities' footprint and the urgent need of sustainability and resilience of urban regions. In this context, the design and management of urban trees and forests, thanks to the recognition of the ecosystem services provided, are increasingly considered as key issues for future cities but they need to be rooted on the following items: a. development of technical and scientific knowledge; b. implementation of research actions; c. innovative and sound management and maintenance techniques; d. continuously updating monitoring and regeneration practices. Doing this, it will be possible to bridge the past and the present towards a proactive future management of nature in cities. As example, the deep knowledge on the history of tree heritage allows an effective strategic planning that includes a sound evaluation and the selection of performing management criteria as well as the setting of suitable urban forest regeneration and implementation interventions. The lessons learned during the 6 decades of activity by the Associazione Italiana Direttori e Tecnici Pubblici Giardini (AIDTPG, i.e. Italian Board of Directors and experts of Public Green Spaces) will be summarized highlighting the implications of climate change effects on urban tree management so to point out the adaptive strategies and actions aiming to optimize monitoring and management for green space maintenance. Several studies indicate the most suitable tree species in improving urban local climate, site conditions, and air quality. Basing on the understanding of the past, new challenges are emerging to apply new findings on tree regeneration, and particularly on street trees renewal by using latest knowledge on eco-physiological efficiency of tree species as well as on their attitude to mitigate and reduce air pollution. Thanks to its role and experience, the AIDTPG facilitated the cooperation between public administrations and private sector or citizens' associations. Experiences of public-private partnership projects such as Life GAIA (Green Areas Inner-city Agreement), whose aim is to compensate greenhouse gas emissions produced by companies through tree planting in urban areas, will be reported.

**Key words:** urban forest management history, climate change, urban forest, street trees renewal, private-public

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## Wild urban woodlands: inappropriate occupier of abandoned spaces?

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Many abandoned areas in our cities are undergoing to spontaneous plant re-colonization and, over time, this process results in real woodlands. Therefore, it is crucial to understand the role of these forests in urban planning by considering the setting of the city currently shaped by the challenges of sustainability and quality of human settlements, and by the need to adapt to climate and socio-economic changes. This work uses a number of examples from the current Italian experience to describe the spontaneous woodlands in urban areas and to outline how these are interpreted in existing planning tools. This approach enabled to highlight some general problems. On the one hand, these woodlands are commonly not recognised in urban plans and their formal designated use is often in contrast with the ecological values connected to forest succession. On the other hand, at higher hierarchical planning levels, approaches adopting different type of restrictions seem to prevail; this is associated to the possibility of classifying these areas as forests within the framework of national and regional laws. A new vision could be suggested, which takes into account the dynamic conditions of these areas and their ecological values within cities by guiding urban planning solutions towards a more broader concept of building public spaces. One example of approach could aim to regeneration of these areas through temporary uses, focusing more on the urban process than on the urban project itself. The overall challenge is to enhance cities' capacity of providing several ecosystem services that aim to improve social well-being and the resilience of the urban environment.

**Keywords:** Abandoned area, wild urban woodlands, urban planning, regeneration, dynamic ecosystems

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## PS 1.4: Changing Environment – *Chaired by Silvano Fares*

### **The Air Quality Shift and Micro Climate of Shillong City in Conjunction with Green Spaces – A Case Study of a City In North Eastern India**

*M. S. Tiewsoh, C. P. Marak*

### **Analysis of heat mitigation strategies of Zen Gardens to extremely hot weather conditions in Kyoto, Japan**

*Lihua Cui*

### **From Lomas to Invasion: A huge loss of biodiversity and green areas on the slopes of Lima**

*Camila Sattler, Nicole Heise*

### **Dendrochemistry to reconstruct environmental pollution in urban forestry context**

*Claudia Cocozza, Roberto Tognetti, Olivier Bachmann, Paolo Cherubini*

### **The role of land use and development processes on tree removal patterns in the City of Melbourne, Australia**

*Thami Croeser, Camilo Ordóñez, Caragh Threlfall, Rodney Van der Ree, David Callow, Stephen Livesley, Dave Kendal*

### **Landslide susceptibility map in the green peri-urban context of Rome**

*F. V. Moresi, M. Maesano, A. Collalti, G. Matteucci, A. M. Ippolito*

# **The Air Quality Shift and Micro Climate of Shillong City in Conjunction with Green Spaces – A Case Study of a City in North Eastern India**

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Policies and guidelines on air quality control and climate change have been framed and implemented as per various studies conducted by researchers from time to time. The present study was carried out to assess the change in air quality and the micro climate of Shillong City which is one of the major cities in North Eastern India. The evaluation of the concentration of pollutants viz. Particulate Matter (PM<sub>10</sub>), Sulphur Di-Oxide (SO<sub>2</sub>) Oxides of Nitrogen (NO<sub>x</sub>) was carried out. The temperature was also recorded along with the evaluation of the pollutants. Sampling and analysis was carried out from January 2015 up to March 2018. Two sites within the city were selected for the study, one is located at a busy junction (Barik Junction) and the other site is located at the office of the Meghalaya State Pollution Control Board, Lumpyngngad which are at an aerial distance of approximately 2Kms from one another. The test methods carried out are as per the Indian Standards. A study on the urban forest covering Shillong City was also conducted with data acquired from Urban Department and previous researches. The urban forest covered is estimated by studying the land use and land cover (LULC) of Shillong City. Results obtained from the study of air quality indicate that there is a difference in the concentration of the pollutant parameters between the two sites. The one with the higher concentration was mainly attributed to the vehicular movement. While in the other station surrounded by forests and with less vehicular traffic. As per the results it is also seen that the level of concentration of pollutants from the year 2015 up to 2018 has been changing gradually with change in development and policies. It is also noted that there is a difference in temperature between the two sites.

**Keywords:** Air Quality, LULC, Air Quality Index, micro climate

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# **Analysis of heat mitigation strategies of Zen Gardens to extremely hot weather conditions in Kyoto, Japan.**

*Lihua Cui*  
*Kyoto University*

Local parks are essential to residents and communities as they offer spaces for communication, local events, and exercises. They can be found every few hundred meters in Kyoto, Japan. However, due to the extreme weather conditions of Kyoto, local parks are mostly underused in summer. Apparently, an abundant amount of greenery or sufficient shadow alone cannot mitigate the uncomfortably muggy hot conditions in local parks. Understanding the strategies for creating thermally comfortable open spaces is crucial, especially in the cities where the weather conditions are unfavorable. Studying successful places from the past which survived the test of time is one of the best ways to understand how to design outdoor spaces thermally comfortable. Kyoto is famous for its beautiful Zen gardens with a long history. They are largely appreciated by people and the cool and calm atmosphere of the gardens contributes to their popularity to a great degree. Therefore, they are satisfactory examples for studying the way to create a comfortable thermal environment in Kyoto. This study is conducted to reveal how Zen gardens are successfully reducing thermal radiation absorption as thermal radiation plays the most considerable role in causing discomfort in hot summer. Field measurement was carried out to record the basic thermal factors (e.g. air temperature, globe temperature, wind velocity, and surface temperature). In addition, analyzation has been performed to investigate the correlation between the structure of the gardens and the surface temperature distribution in gardens.

**Keywords:** Thermal comfort, Thermal environment, Zen gardens, Surface temperature

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## **From Lomas to Invasion: A huge loss of biodiversity and green areas on the slopes of Lima**

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The objective of this presentation is to discuss the current crisis of lomas ecosystem, what lead to it and how it could be reversed. FICUS works in the slum areas of Lima, which first became inhabited when land invasions occurred in the ecosystem of lomas. Nowadays, lomas only remains as patches of vegetation which represent 7% of Lima's province territory (SERPAR, 2014). Lomas are an ecosystem that harbors great flora biodiversity and is an habitat for 850 vascular species and 215 endemic species (SERPAR, 2014), many of which still lack research. Also known as fog oasis, lomas are distributed along the coastal desert of Ecuador, Peru and Chile, and variate during the year depending on the season. During the winter months, cold ocean temperatures conduct the formation of fog that then intercepts the Andes foothills raising the humidity level and allowing vegetation to grow. Lomas play a part in mitigation and adaptation to climate change through ecosystem services such water catchment for the aquifer, carbon storage, improvement of air quality, erosion and landslide prevention, and are also recreational green areas for the citizens. All of these are important in a city like Lima that holds a raising population, urban expansion and an increasing demand on housing and natural resources like water. This situation lead to the creation of informal settlements that established on the peripheries of the city, affecting negatively and threatening the existence of lomas because of the lack of a waste management program and the change of soil use that keeps the humidity away from soil and vegetation. FICUS works with the local communities to address these issues in order to conserve the urban green areas in a way that is also beneficial for them and the rest of the citizens. We would like to present this current crises in Lima and to complement this presentation with the other abstract we have submitted in which we explain the work Ficus is performing in order to safeguards urban forests in Lima.

**Keywords:** Ecosystem, biodiversity, urban growth, ecosystem services

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## **Dendrochemistry to reconstruct environmental pollution in urban forestry context**

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Tree rings record environmental events. Studying and dating tree rings may help understand how environmental conditions have changed in the past, when such information is not available from other sources, and how they might affect ecosystems in the future. Trees are affected by environmental pollution in relation to the level of pollutants and their exposure to them, tree species, environmental conditions, geographical context and the location of trees in relation to pollution sources. Tree-ring chemical analyses, i.e., dendrochemistry, provide a tool to reconstruct the temporal and spatial dynamics of pollutants in the environment. Trace elements can be deposited onto plant surfaces (e.g., stem, bark), absorbed from the atmosphere by foliage and up-taken from the soil by the roots (and accumulated in the xylem). Yet, physiological processes must be taken into account. Indeed, the translocation of trace elements depends on tree species and chemical element: cation exchange processes may occur within the xylem sap, fluctuations in element concentration can occur from one annual ring to the next. In this study, we considered urban environments with different pollution levels and sources, exposure intervals, and industrial process intensities. Tree-ring chemical content was analyzed through laser ablation ICP-MS. The study of tree cores sampled in three industrial urban areas, Venafro (*Quercus pubescens*, Italy), Terni (*Q. pubescens*, Italy), and Chippis (*Pinus sylvestris*, Switzerland) revealed the potential of tree rings as sensitive indicators of changes in anthropized ecosystems, detecting specific signals of the considered pollutants to reconstruct past environmental conditions in urban areas.

**Keywords:** Dendrochemistry, environmental pollution, urban forestry, trace elements, tree rings

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# The role of land use and development processes on tree removal patterns in the City of Melbourne, Australia

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Urban trees are critical for the sustainability of cities the world over. Many cities have ambitious targets to increase urban tree planting and canopy cover, yet many municipal governments also spend millions of dollars removing trees every year. Trees at the end of their useful life are likely to go into decline and be removed. This means that some streets and parks often experience rapid loss, absence, and slow recovery in tree canopy cover, causing a reduction in the services trees provide, which are more significant as trees age and increase in size. Previous research suggests that the causes for removal are related to trees posing a risk to humans and property, trees hindering construction activities related to urban development or infrastructure removal, and the need for diversifying tree species. In addition, tree-removal and canopy-loss patterns at the big spatial scale are influenced by land-use and socioeconomic factors, including zoning, income, population density, and development permits. However, most studies derive these patterns from satellite-based data, so it is still unclear what the patterns and drivers are at the individual tree level. Some unknowns include: which species and age/size classes are being removed, which land-use types (i.e., street or park) are associated with removals, and how removal patterns intersect with urban development activities. To answer these questions, we report on an investigation on tree-removal and tree-loss patterns using data from the City of Melbourne. We present results that show the spatial, age/size, and species distribution of tree-stem losses, as well as canopy-cover losses between 2010 and 2017, and results from a proximity analysis at 10m, 50m, and 100m around City of Melbourne development activities a tree-removal site.

**Keywords:** urban sustainability; urban ecology; urban forest management;

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## Landslide susceptibility map in the green peri-urban context of Rome

*F. V. Moresi, M. Maesano, A. Collalti, G. Matteucci and A. M. Ippolito*

The correlation between the absent of forests and the occurrence of landslides is well-know. In fact, the forests provide a protection in the soil degradation and erosion through the trees presence and roots contribution. In shallow terrains, soil cohesion is enhanced by roots while the trees modify the soil moisture through increased evapotranspiration. In addition, in deep soils, the roots create macropores with hydrological drainage networks. However, extreme rainfall can be triggering the soil movement because soil moisture is inversely related to soil cohesion and plasticity. For this reason, identify areas susceptible to landslides is fundamental for territory management especially for the damage they could cause in urban and rural areas. In the light of this, we propose a GIS (Geographic Information System) approach to obtain risk maps for the assessment of landslide susceptibility based on the Shallow Landslides Stability Index (SLSI) model. The SLSI model considering the effect of root cohesion and it based upon the infinite slope stability model. This method was applied in a peri-urban context of Rome, in the green area of Monte Mario, for determining the Landslide susceptibility map. The map shows that close to 27% of the area has a high susceptibility to mass movements, 32% presents medium susceptibility and 41% a low threat. This area is valuated to high hydrogeological risk by the basin authority of the Tiber (Hydrogeological Structure Plan - PAI).

**Keywords:** Ecosystem services, urban forest, landslide, management territory; GIS

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## **Parallel Session 2 - The Present (1)**

## PS 2.1: Changing People – *Chaired by Gu Lin*

### **CommuniAct - Avenue to Changing Urban Cities and People**

*Carlo B. Gomez, Al Zelaya, Romina Magtanong*

### **Professional Gardens can contribute important knowledge and resources to urban forestry; The Morton Arboretum as a leading example in the US**

*Nicole Cavender, Lyida Scott, Gerard Donnelly*

### **Girls Talk Trees: Examining barriers to women in arboriculture and urban forestry across Canada and the United States**

*Adrina C. Bardekjian, Cecil Konijnendijk van den Bosch, Lorien Nesbitt, Barend Lötter*

### **Human faces, forest places: An examination of urban green equity in multicultural cities**

*Lorien Nesbitt, Cecil C. Konijnendijk, Michael J. Meitner, Stephen Sheppard, Cynthia Girling*

### **Creating a New Narrative: Storytelling for Social Change**

*Sarah Marder*

### **Social representations of nature - can they contribute to understanding citizen relation with urban trees**

*Rik De Vreese*

## **CommuniAct - Avenue to Changing Urban Cities and People**

*Carlo B. Gomez\*, Al Zelaya, Romina Magtanong  
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The more than two decades experience of Puerto Princesa City Feast of the Forest activity that brought together citizens from all walks of life to plant millions of trees in previously denuded areas was quite an achievement. However, tree care and maintenance is insufficient and left to the hands of the few. The experience necessarily needed a simultaneous contemporary approach to essentially change the nature of cities to improve the nature of people. Following adoption of the Essence of Community-Act and Stewardship, the first Balayong tree planting festival was held last July 29, 2017. Government employees, non-government organizations, academe, other civic groups, as well as private individuals planted approximately 1300 balayong (*Cassia nodosa*) trees within the government center. Stewardship certificates were awarded to tree planters during a celebration ceremony to acknowledge efforts, create excitement, and promote community stewardship of the project. As a result, most of the planting groups returned to nurture the trees they planted, and stewardship mapping (STEW-MAP) of the park project is planned. Because of the positive community participation, the city received funding support from national agencies for open space and soft scape improvements. Although the establishment of Balayong Tree Park is in early development phases, the project has helped demonstrate the role of trees as a critical part of urban infrastructure and promoting community involvement. The city is now legislating community-level tree ordinances that require the planting of uniform trees in all residential housing projects, subdivisions, and villages. Maintenance and tree preservation efforts in response to urban development are also being improved. Ornamentation projects of other public spaces are also planned. This presentation will explore how community tree planting, stewardship, protection and management can be achieved collectively to provide an improved urban environment with multiple benefits for all.

**Key words:** CommuniAct, Balayong, STEW-MAP, i-Tree

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## **Professional Gardens can contribute important knowledge and resources to urban forestry; The Morton Arboretum as a leading example in the US**

*Nicole Cavender\*, Lyida Scott, Gerard Donnelly  
The Morton Arboretum*

Developing healthy forests in urban communities is reliant on different interest groups sharing a common ambition, working together in partnership and playing to their respective strengths. Professional botanical gardens have an increasingly important role to play globally in support of the urban forest, especially in relation to their key strengths: 1) botanical & horticultural knowledge and 2) public education, outreach & training. A leading example is The Morton Arboretum, located near Chicago, Illinois, the third largest metropolitan region in the United States of America comprised of 8.4 million people across 12,227 km<sup>2</sup>. The Arboretum has strategically invested in finding solutions to better care for and establish trees in the built environment at both a research and applied level. It engages scientists through its Center for Tree Science to advance the knowledge needed to improve standards for growing, managing and selecting trees in the built environment. The Arboretum also leads a coordinated effort across the Chicago region to build a healthier and more diverse urban forest through its Chicago Region Trees Initiative. This is the largest such initiative in the country, covering more than 400 different governmental jurisdictions, with leading organizations and agencies working together across the seven-county metropolitan region. To develop and tailor strategies for improving the urban forest, an extensive data set on the urban forest has been collected and combined with national census, human health data, environmental statistics, management capacity, and other relevant information. Priorities among urban forest needs have been established at regional and local scales, and across public and private land ownership. The CRTI has developed resources, programs and approaches to help communities and individuals more actively and appropriately manage their portions of the urban forest, all of which has application for the global community.

**Key words:** botanical gardens; Chicago Region Trees Initiative; strategies for urban forestry; community engagement; urban forest data

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# **Girls Talk Trees: Examining barriers to women in arboriculture and urban forestry across Canada and the United States**

*Adrina C. Bardekjian<sup>\*</sup>, Cecil Konijnendijk van den Bosch, Lorien Nesbitt, Barend Lötter  
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Arboriculture and urban forestry are seen to be male-dominated industries. Historically, this was the case being that operations were physical and labour-intensive. Despite the challenges that women have faced in these industries, in recent years, we are seeing more young women embrace opportunities and pursue careers in these fields. Arboriculture and urban forestry are growing fields of research and practice where women's contributions can be represented, communicated and celebrated more broadly. More research is focusing on gender balance and the diverse communities that comprise both traditional and urban forest sectors. There is also more attention being paid to this area in practical operations and management. The central objectives of this research are to assess the current status of women's participation in arboriculture and urban forestry, with a focus on identity constructions and diversity; to examine various narratives relating to barriers, experiences, motivations and perspectives of women by women; and to enhance and encourage the participation of women in the arboricultural and urban forestry labour markets. Methods included an online survey of women working in these industries in both Canada and the United States. Results yielded from over 500 respondents, provide valuable insight into how women participate in and perceive, influence and engage within the arboricultural and urban forestry workforce.

**Keywords:** equity, gender, labour, narratives, social inclusion

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## **Human faces, forest places: An examination of urban green equity in multicultural cities**

*Lorien Nesbitt\*, Cecil C. Konijnendijk, Michael J. Meitner, Stephen Sheppard, Cynthia Girling  
University of British Columbia, Faculty of Forestry, Department of Forest Resources Management*

Urban forests provide a wide range of ecosystem services to urban residents that improve the urban environment and human wellbeing. However, research suggests that racialized status, and its accompanying power dynamics, play an important role in determining residents' access to and governance of urban forests. As cities become increasingly multicultural spaces, this research explores the role of racialized identities in urban forest access and governance via 1) a large-scale spatial analysis of race and urban forest equity in 10 urban areas in the United States, and 2) a case-based analysis of key barriers to both distributional and recognition equity in multicultural cities. Results: The spatial analysis indicated that racialized identity is increasingly associated with limited access to urban forests as cities increase in size and density, and as racialized populations become more prominent elements of urban society. The case-based analysis identified various race-related barriers to urban forest equity, including multiple conflicting identities and urban forest priorities, language and cultural barriers, a lack of sense of ownership or place, and urban forestry hiring policies. Discussion: Cities are increasingly becoming spaces in which the world's populations meet and co-create their environment. This reality creates opportunities for mutual learning and improved resilience but can also lead to increased inequity in our access to and governance of urban forests. This research suggests that, paradoxically, such tensions increase as multiculturalism increases, highlighting the urgency of the issue and key factors that encourage its growth. We hope that our findings can stimulate conversations on strategies to improve urban green equity in multicultural cities, highlighting the importance of diversity and inclusion in urban forest governance.

**Keywords:** Multiculturalism; Urban forests; Equity; Governance

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## Creating a New Narrative: Storytelling for Social Change

*Sarah Marder\**

*Director of a feature-length documentary THE GENIUS OF A PLACE*

We environmentalists know in our bones that if we protect Nature, she will protect us. We also know that cities are the places in which population, consumption, emissions and waste are most concentrated and thus absolutely central to combating climate change. One of the largest challenges ahead of us is changing the narrative among all players, including the general public, helping all of us to understand and accept the gravity of the situation, without frightening ourselves into paralysis. We also need to inspire and motivate all of us to pull together in a new and more thoughtful direction so that together we can actually resolve many of the challenges that our societal paradigm has so thoughtlessly created. We can't place our faith blindly in cities becoming "smart". Rather, we need to all become wise and help our communities to make choices that reflect our collective wisdom. Much of this work will depend upon our storytelling abilities to shape a new narrative. This session would aim to provide some concrete tips as a form of empowerment and capacity building of practitioners, so that they can improve their storytelling abilities to spread their messages as far and effectively as possible. The presentation would include at least one video.

**Keywords:** storytelling, narrative, restorative, cities, nature

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## **Social representations of nature - can they contribute to understanding citizen relation with urban trees**

*Rik De Vreese\**

*Contracted Urban Forestry expert to the European Forest Institute*

Social representations of nature describe how stakeholder groups perceive nature and communicate about nature. Our research illustrated how social representations of nature build on two dimensions: a culture versus nature continuum, and considerations on human-nature relationships. Our presentation will build on the social representations of nature concept, and will explore how the concept can contribute to understanding urban citizens relation with urban forest and urban trees. Understanding this relation is important for planning and management of urban forests and urban trees and to avoid conflicts on urban trees. Indeed, urban forestry is working for and with people - but to be able to work with and for citizens on urban trees, we need to know how people perceive and represent urban trees in their daily life.

**Keywords:** public perception, social representation of urban trees, stakeholder groups, human-nature relationship

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## PS 2.2: Changing Spaces and Places – *Chaired by Gianmichele Cirulli*

### **Requiem for Wilderness in Dhaka**

*Dhrubo Alam, Fatiha Polin, Afreen Ahmed*

### **Cemeteries as eternal urban green-spaces? Shifting uses in the United States and Sweden**

*R. A. Rae, J. Östberg*

### **The Urban Forest in the age of urbanization**

*Samaneh Sadat Nickayin*

### **Green Infrastructure in Small Communities: Constraints and Catalysts**

*Paul D. Ries, Jenna Tilt*

### **Beyond the trees: designing shrub communities for the urban forest**

*John Rayne, Claire Farrell, James Hitchmough, Audrey Gerber*

### **Reforestation of Degraded Slopes of the City of Rio de Janeiro with Community Mobilization**

*Luiz Octavio de Lima Pedreira*

### **Exploring and demonstrating the best socio-economic, and environmental benefits of the green infrastructure technology in Uganda**

*Fortunate Ayebare, Lawrence Luzinda, Edward Mutawe*

## Requiem for Wilderness in Dhaka

*Dhrubo Alam\*, Fatiha Polin, Afreen Ahmed*  
*Bengal Institute for Architecture, Landscapes and Settlements*

The capital of Bangladesh, Dhaka is a megacity with one of the highest population density in the world. Historical documents and records prove presence of marsh or shallow land and natural groves. There were also traces of wilderness and wildlife, canals for accessibility and drainage. On top these, Mughals passion for garden gifted Dhaka with few beautiful ones. Since the independence in 1971, Dhaka became the sole administrative, economic and political center and the phenomena of influx of people increased significantly. Moreover, decades of growing economy accelerated the unplanned rapid urbanization. Gradually, the city started losing its greeneries, waterbodies and open spaces. As a consequence, myriads of problems like waterlogging, air, water and noise pollution, congestion etc. emerged. Though, there have been projects on improving the air quality or environment, or restoring waterbodies sporadically, they never deemed successful or sustainable. Dhaka needs an integrated approach to overcome the existing condition by addressing the physical, cultural and historical phenomenon and context of this city. For our research, we have considered the areas: Wari and Narinda; which bears characteristics of both old and new part of the city. And our every design endeavor reflects this ecological consciousness like green urban corridor with site specific native plants, improved walkability on shaded promenade, restored water bodies with natural purification system, creating urban forest to reduce carbon emission, minimizing traffic congestion without compromising accessibility etc. This paper briefly depicts the current challenging situation, presents a mechanism to transform the particular area with an integrated approach, incorporating urban forest, as a case study, exploring scopes and opportunities. Moreover, this might project a vision to replicate the model around other portions of the city with similar circumstances.

**Keywords:** Dhaka, Urban Forest, Green Design

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# Cemeteries as eternal urban green-spaces? Shifting uses in the United States and Sweden

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As cities around the world increase in density, and the number of urban green spaces decrease, the role of cemeteries as urban parks is becoming increasingly important. Cemeteries are important green spaces in urban environments, offering nature's benefits to city residents and thereby contributing to greener, healthier and happier cities. This research identifies changing trends in the use of cemeteries in modern urban environments found in the United States and Sweden. This study explores the historical and modern use of cemeteries as urban green spaces in both the United States and Sweden. Using a cross-cultural lens, this research compares the differences in the governance of cemeteries to explore cultural meanings and current social uses and explores historical as well as modern landscape management practices and techniques. Comparisons are made between cemeteries in the United States and Europe, with a focus on the Nordic context and the New York City metropolitan region of America. Case studies of the Green-Wood cemetery in Brooklyn, New York in the United States and the Östra kyrkogården (Eastern cemetery) in Malmö, Sweden are compared. The case studies include site observations, photography, event participation and semi-structured interviews with managers in both cemeteries. There have been many shifts in the use of the Swedish cemeteries and in the case study of Östra kyrkogården there has been a change in the last ten years where it is now more socially accepted to exercise in the cemetery. Green-Wood Cemetery is working today to be considered a public garden by expanding their public programming and botanical amenities as well as their role in environmental advocacy through projects and collaborations, both scientific and educational. This study documents these changes over time, and the visions that both Green-Wood cemetery and the Östra kyrkogården have for their future.

**Keywords:** Cemetery, Urban Green Space, Parks, Sweden, United States

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# The Urban Forest in the age of urbanization

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The present paper seeks to reflect on the connotation of urban forest(ry), in line with related emergent holistic theories. Today, the whole planet is urbanized and planners debate “Planetary Urbanization”, economists discuss “Global City”, ecologists describe planet’s biodiversity hotspots connections, and climate changes warns “global” crisis. In such scenario, focusing on the forestation approaches in urban and peri-urban “edges” might be reductionist. If the city is everywhere, and everything is city, if the urbanized world now is a chain of metropolitan areas connected by places and corridors of communication, then what is not urban? And above all, which forests are not urban forests? According to a wide a range of holistic theories, the paper attempts to recreate a framework of dialectical approaches, to review the role of design in urban forests for upcoming 21th century, when the climate change, population growth, implosions and explosions of urbanization, lack of arable land and food are unavoidable. The main criteria that drives the paper, aims to reverse the concept from “the impacts of forestation on urban area” to “the impacts of the urban area on forestation”, not in terms of ecological impacts but in terms of design and spatial configurations of forests. The paper emphasizes the importance of Landscape Urbanism, as an interacting and holistic approach, that becomes the “driver” of territorial transformations, replacing the previous idea of forestation as a “balance” to urban growth.

**Keywords:** Urban Forestry; Holistic approach; Landscape Urbanism; Urban Growth

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# Green Infrastructure in Small Communities: Constraints and Catalysts

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Green Infrastructure projects that balance the built and natural environments are becoming more common in large metropolitan areas. But for smaller, more rural towns and cities, and urbanizing areas, Green Infrastructure may be more of an ideal or a concept than an actual planning process or an on-the-ground example. Are Green Infrastructure projects feasible in smaller communities that might lack the resources and staffing of their more urban counterparts? How do rural and urbanizing environments perceive Green Infrastructure projects and implementation? Do perceptions differ by regulatory mandates or climatic zones? What are the constraints and catalysts to implementing successful Green Infrastructure in smaller communities with diverse populations, needs, and challenges? These are some of the questions answered by a recent Oregon State University (US) study that featured two pilot projects, qualitative interviews and analysis, and in-depth observations of two implementation cases. The presentation will explore the common themes of constraints and catalysts, the strategies employed to deal with constraints, the primary needs of the local communities, and the routes to build capacity taken by different communities in pursuit of Green Infrastructure goals.

**Key words:** Green Infrastructure, Small Communities, Land Use Planning

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# Beyond the trees: designing shrub communities for the urban forest

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Definitions of the urban forest are progressively moving beyond trees. They increasingly describe complex urban ecosystems with different structural elements and diverse vegetation systems; designed and managed to deliver significant ecosystem service benefits. While there is growing evidence of these benefits linked directly to trees and tree communities, there is little published on the contributions that other vegetation communities in the urban forest provide. This paper explores and reviews one of these communities in detail: shrub plantings. It examines natural shrub-dominated plant communities across the globe through their ecology, structure and function and proposes a typology for shrub plantings in urban landscapes. The benefits from using shrubs are discussed, along with aspects of design, implementation and maintenance, including criteria to guide plant use and selection for different applications. The paper also reports on novel research using shrubs being undertaken in Melbourne, Australia: *The Woody Meadow Project*. The project is investigating the use Australian shrubs from Mediterranean-climate plant communities in designed landscapes that are low maintenance, floristically rich and ecologically diverse. Plants were selected based on their response to coppicing, but were also assessed against specific aesthetic, ecological, horticultural and functional traits. The results from both coppice and field experiments involving 56 different plants have been positive and demonstrate how designed shrub communities with long seasonal display outcomes and low resource inputs can be successfully used in Mediterranean-climate urban forests.

**Keywords:** Ecosystem services, green infrastructure, woody perennials, woody meadow

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# Reforestation of Degraded Slopes of the City of Rio de Janeiro with Community Mobilization

*Luiz Octavio de Lima Pedreira\**

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The City of Rio de Janeiro was built over wetlands between beaches and mountains, with natural vegetation replaced by plantations of sugar cane and coffee or suppressed for city construction since 16th century. The plantations on slopes were later abandoned and colonized by invasive alien grasses, especially *Megathyrus maximus* (Jacq.) B.K. Simon & Jacobs adapted to fire common on these slopes. The replacement of forest by agriculture and later by grass, associated with urban growth, resulted in scarcity of potable water, which left to a first forest reforestation in the second half of 19th century, through pioneering work of Major Acher, who planted approximately 100.000 trees, continued by Barão d'Escragnolle, mainly with the purpose of protecting the springs and increasing the flow of the rivers used for water supply to city inhabitants. At the same time Pereira da Cunha begin planting *Eucalyptus* sp. in Quinta da Boa Vista Park. More than half a century later the Institute of Geotechnics, after the storms of 1966, started reforesting slopes to reduce slope erosion. In the 1980s the Department of Parks and Gardens continued this work, with the same purpose. The work was done with its staff and contractors. From 1987 onwards, the successful experience of Community Mobilizations in slumps / favelas was taken to reforestation of slopes, through the Mutirão Reforestation project. This successful experience, over the last 30 years, has planted more than 3,000 ha in 150 areas of city's slopes and mangroves, with the participation of residents of communities near these areas, under a partial-paid regime. Today, the program has 500 employees in 80 communities. Since 2009, another project, Rio Capital Verde reforests new areas. These projects use more than 150 different species of trees, most native to the Atlantic Rainforest. Five city nurseries produce one million seedlings per year.

**Keywords:** ecological reforestation, community involvement

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## Exploring and demonstrating the best socio-economic, and environmental benefits of the green infrastructure technology in Uganda

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*2. Makerere University Kampala, Uganda*

**Aims:** As a measure to counteract the effects of urban sprawl, with the continued growth of cities worldwide, different modes of urban greening are being increasingly recognized. The main objective of this study is to explore and demonstrate the best socio-economic and environmental benefit of green infrastructure technology.

**Methods:** The study was compiled from various literature documents, this would help in the re-development or re-establishment of Green Infrastructure (GI) activity for developing countries especially Uganda.

**Findings:** Currently, rapid growth of population and the high density cities in Uganda are major environmental problems, due to inadequate planning and lack of attention; the GI resources (urban ecosystem) of Ugandan cities are also being rapidly depleted. Hence, this study has assessed different GI experiences. The study has also discovered how Uganda socially and economically benefited from GI, and assessed the response of GI to urban environment/ecosystem. Thus, as many studies confirmed that, GI has a multi-functional social, economic, cultural and environmental benefit which provide for urban and pre-urban dwellers. Therefore, this study mainly focused on the multifunctional benefit of GI which has contributed to urban ecosystem. It includes; social benefit (health and wellbeing's, recreational and educational value); economic benefits (economic value, energy saving, and green job opportunities) and the environmental response/benefit of GI (includes biodiversity/ecological response, carbon reduction and sequestration, improving urban air quality and climate change and adaptation response). It also captures different scholar's view and opinions about the benefit and significance of GI to the entire communities. These documents constitute a contribution to recognize the importance of retaining greenery in cities chiefly, although not solely, as a countermeasure to urban sprawl and its environmental impacts.

**Conclusion:** Urban greening here represents a cost-effective (soft) approach that is an effective tool as part of sustainable development. Finally, the study attempts to bridge for further source of information and endeavors to indicate the existing research gaps about the issue.

**Keywords:** Socio-economic, Environmental, Green infrastructure technology

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## PS 2.3: Changing Environment – *Chaired by Chris Baines*

### **Exploring the role of urban forestry in Urban National Parks**

*Clive Davies, Maggie Roe, Tim Townshend, Catharine Ward Thompson, Natalie Marie Gulsrud, Qianqian Qin*

### **Wild urban forests and wood biomass short rotation landscape laboratories on former brownfield sites Ruhr Area, Germany nature based solutions in place making and place keeping**

*Renate S. Spaeth*

### **Urban forest in Latin America: challenges and opportunities for research and practice**

*Tahia Devisscher, Cynnamon Dobbs, Francisco Javier Escobedo, Demóstenes Ferreira da Silva Filho, Mónica Nuria Navarro, Camilo Ordóñez, Luis Alberto Orozco Aguilar*

### **Urban Forests in Latin America: A Synthesis of Research & Management Practices**

*Camilo Ordóñez, Tahia Devisscher, Francisco Javier Escobedo, Luis Alberto Orozco Aguilar, Mónica Nuria Navarro, Cynnamon Dobbs, Demóstenes Ferreira da Silva Filho*

### **Streamlining Tree Selection: Biodiversity, Ecosystem services and Tree needs in Padova (Italy)**

*Claudia Alzetta, Federico Agostini*

### **Taking care of New York City's urban forest: Understanding civic environmental stewardship outcomes**

*Johnson Michelle, L. Svendsen, Erika S., Campbell Lindsay K.*

### **A review of climate change adaptation strategies in major cities in Uganda**

*Fredrick Lwasampijja, Emma curate Zzalwango, Fred Joe Kiyemba*

### **Studying indicator parameters of ecological tolerance of trees under conditions of the city of Yerevan**

*Gayane Nersisyan*

## Exploring the role of urban forestry in Urban National Parks

*Clive Davies<sup>1\*</sup>, Maggie Roe<sup>1</sup>, Tim Townshend<sup>1</sup>, Catharine Ward Thompson<sup>2</sup>, Natalie Marie Gulsrud<sup>3</sup>,  
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The possibility of identifying ‘Urban National Parks (UNP)’ is rapidly rising up the political agenda. The discussion and documentation on these provides a poor articulation of their conceptual basis or how they might work in reality. There is however, no shortage of promotion and ‘hype’. The Mayor of London has indicated that in spring 2019 he wishes to announce that London will become the world’s first ‘National Park City’ and promoters have already suggesting that other cities might follow; Cape Town and Rio de Janeiro have been mentioned in this regards. Based on the the findings of a pilot project funded by the Catherine Cookson Foundation at Newcastle University (UK) this presentation focuses on the role that trees, woodlands and biophysical green infrastructure could play in an Urban National Park. This is achieved by interpolating the FAO Guidelines on urban and peri-urban forestry (2016) into the present discourse on Urban National Parks. The aim is to see what impact urban forestry can make in terms of health and wellbeing potentials, green infrastructure planning, new urban agendas, green spaces as cultural assets, city heritage and nature-based solutions to greenspace planning in a designated Urban National Park. The presentation references the development of a potential assessment using an experimental typology that is based on the original objectives of National Parks, a mosaic governance approach and existing landscape, heritage and health typologies.

**Keywords:** Urban National Parks, Biophysical green infrastructure, Nature based solutions, Health & well-being, Mayor of London

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## **Wild urban forests and wood biomass short rotation landscape laboratories on former brownfield sites Ruhr Area, Germany nature based solutions in place making and place keeping**

*Renate S. Spaeth\**

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The Ruhr Metropolis Region (North Rhine Westphalia) is the most densely populated multiple-city region of Germany. Its unique history reveals more than 150 years of industrial landscape development dominated mainly by coal mining, steel and chemical industries. After the decline and political end of coal mining following the end of the Second World War structural changes have had deep impacts on the regional society as well as on the reclaiming of large brownfield sites. Since 1989 the state government of North Rhine Westphalia has supported the economic, social and cultural change. One of the main state-supported projects is Emscher Landscape Park (ELP) as a consequence of the International building exhibition Emscher Park (1989-1999). One ELP - project concentrates on the wild urban forests and short rotation woodlands. The presentation will highlight recent pilot projects in the area and their multifunctional aims for place making, climate mitigation, biodiversity and participation on former brownfield sites in the city of Gelsenkirchen. The importance of urban forestry and a vivid green urban infrastructure will be shown as well as its contribution to climate mitigation, environmental education, health and recreation and biodiversity. The presentation will address the strong need for cooperation with land owners, land users and civil society in order to reach the aim of a better urban green future. The presentation will be accompanied by a video produced by the European Environmental Agency (EEA) in 2010, the International Year of Biodiversity.

**Keywords:** industrialisation; brownfield sites; urban forestry and urban greening; participation

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# Urban forest in Latin America: challenges and opportunities for research and practice

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Mónica Nuria Navarro<sup>1</sup>, Camilo Ordóñez<sup>5</sup>, Luis Alberto Orozco Aguilar<sup>5</sup>*

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Urban areas face several challenges, including accelerated urbanization, a deteriorating natural environment, increasing climate risks, and new demands for participatory governance processes. Nature-based solutions, such as enhancing the services provided by urban forests, have been proposed to help cities address many of these challenges. Although such initiatives are popular in the US, Canada, Europe, and Australia, where research on urban forests has expanded in the last twenty years, it is unclear if these can succeed globally. Latin America is one of the most urbanized, socially inequitable, and climate-vulnerable regions in the world. Most of its population lives in cities, yet many of these cities are in coastal and mountain areas that are highly vulnerable to a wide range of environmental stressors, with increasing socio-economic inequity, such as unequal access to green infrastructure. Despite the potential role urban forests and nature-based solutions could play in this context, there are few, if any, regional-scale assessments on how urban forest research and management contribute to urban sustainability and resilience in the region. Our study aims at addressing this gap, and providing a baseline understanding of urban forestry and its potential in Latin America. Based on a literature review and survey data collected from a wide range of practitioners and researchers working on urban forests in the region, we propose a working definition for urban forestry in Latin America grounded in local-lived realities, regional priorities, as well as in urban planning strategies. We also assess current capacities, barriers, and opportunities influencing the development of and potential for urban forestry in the region. We discuss these findings in comparison to other regions, and conclude with a set of recommendations to consider in future urban forestry and green, resilient city development plans in Latin America, particularly in the context of climate change.

**Key words:** Urban forestry, Latin America, nature-based solutions, urban planning

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# Urban Forests in Latin America: A Synthesis of Research & Management Practices

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While nature-based solutions to urban sustainability problems are gaining traction in North America, Europe, and Australia, it is unclear if these initiatives can succeed elsewhere. It is important to understand to what extent are greening agendas playing a role in increasing sustainability in other areas of the world, specially areas where most urbanization is taking place, and where the environmental effects of global change are expected to be severe. Latin-American cities are interesting case studies to explore how urban forests, defined here broadly as all the trees in urban areas, are playing a vital role in the urban sustainability and resilience agenda. Cities contain most of the population of the region, yet remain highly inequitable and are critically vulnerable to climate change, due to their mountainous or coastal locations. While urban forests play a big role in solving urban environmental and psycho-social problems in these cities, to this day, no regional-scale assessments on research and practice in urban forests exist for Latin America. To address this gap, we present results on a systematic academic literature review of urban forest research in Latin America and the Caribbean. This review is complemented with an analysis of selected urban forest management plans from key cities in the region. We analyse this body of literature through a qualitative lens to extract trends in research and management themes. The plans are analysed through mixed quantitative and qualitative content-analysis techniques with the goal of extracting management themes, focusing on desired values, objectives, indicators, and targets of management. This assessment will provide insights into Latin-American experiences in urban forestry, which can complement, advance, or contend current global urban forestry paradigms.

**Keywords:** socio-ecological systems, urban ecosystems, resilience, Latin America

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# Streamlining Tree Selection: Biodiversity, Ecosystem services and Tree needs in Padova (Italy)

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Careful planning and selection are crucial for an urban tree's long-term success. The City of Padova manages more than 47.000 public trees (in gardens, parks and along streets) and in order to guarantee biodiversity over 255 different tree species, cultivar and selections are used. Due to the growing importance given to ecosystem services the city is developing a decision-making protocol to ensure consistency and accuracy throughout the urban forestry program. This protocol considers the most significant criteria impacting tree selection both among ecosystem services or disservices (e.g. heat control, carbon storage capacity, sense of place, visual amenity – toxicity, interfering fruit and leaves fall, odour nuisance) and tree needs and morphological traits (specific sun conditions, space for the crown, space for the root system). The assessment of the different ecosystem services and disservices provided by each tree species is achieved using scientific literature, experts' knowledge and online database, while morphological traits of trees are identified thanks to experts' opinion and scientific knowledge. A master spreadsheet is being developed that identify the ecosystem services/disservices and the distinguishable functional traits of all the 255 tree species. Combining the science-based information on trees needs with the different site conditions it is possible to assign every tree species to its most appropriate biotope, matching the desired ecosystem services. Space criteria are the key limiting factor to maximize long-term plant survival, together with high aesthetic results on which citizens are primarily focused. Importance is stressed on portraying trees as growing and living green infrastructure that must be properly respected by humans to provide them quantifiable environmental benefits.

**Keywords:** Tree selection, ecosystem services, space criteria, urban public trees, biodiversity

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## **Taking care of New York City's urban forest: Understanding civic environmental stewardship outcomes**

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Increasingly, the critical role of civic organizations in urban governance is recognized. Some civic organizations advocate for, conserve, educate about, manage, monitor, and transform the local environment; in essence, they steward the city's environment, including urban forests. The large number of individuals and organizations in cities result in complex governance networks; how these organizations together can affect ecological conditions has been theorized, but have been empirically measured infrequently. In 2017, the New York City Stewardship Mapping and Assessment Project (STEW-MAP) collected survey-based data on environmental stewardship organizational networks, individual organizations' perceived outcomes, and other organizational-level characteristics of environmental stewardship groups. Here, we apply this dataset of urban environmental stewardship organizations to investigate how civic organizations can influence cumulative environmental outcomes in New York City. Beginning with perceived outcomes, we also consider available plot-level data on forest and wetland conditions and remotely-sensed land use/land cover data, to gain an understanding of overall system changes. From this empirical analysis, we identify how perceived environmental outcomes relate to organizational characteristics, as well as overall ecological condition. We also identify the potential for future social-ecological analyses in cities like New York, to better understand these linkages between social organization and environmental outcome, in a social-ecological manner.

**Keywords:** stewardship, outcomes, civic, social-ecological

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# A review of climate change adaptation strategies in major cities in Uganda

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**Aims:** The task of adapting cities to the impacts of climate change is of great importance—urban areas are hotspots of high risk given their concentrations of population and infrastructure; their key roles for larger economic, political and social processes; and their inherent instabilities and vulnerabilities. Yet, the discourse on urban climate change adaptation has only recently gained momentum in the political and scientific arena. This paper reviews the recent climate change adaptation strategies of nine selected cities and analyzes them in terms of overall vision and goals, baseline information used, direct and indirect impacts, proposed structural and non-structural measures, and involvement of formal and informal actors.

**Methods:** Adaptation strategies and challenges in two Ugandan cities are analyzed in detail, namely Kampala and Mbale. The paper thereby combines a review of formalized city-scale adaptation strategies with an empirical analysis of actual adaptation measures and constraints at household level.

**Findings:** By means of this interlinked and comparative analysis approach, the paper explored the achievements, as well as the shortcomings, in current adaptation approaches, and generated core issues and key questions for future initiatives in the four sub-categories of: (1) knowledge, perspectives, uncertainties and key threats; (2) characteristics of concrete adaptation measures and processes; (3) interactions and conflicts between different strategies and measures; (4) limits of adaptation and tipping points. In conclusion, the paper calls for new forms of adaptive urban governance that go beyond the conventional notions of urban (adaptation) planning. The proposed concept underlines the need for a paradigm shift to move from the dominant focus on the adjustment of physical structures towards the improvement of planning tools and governance processes and structures themselves.

**Conclusion:** There is need to link different temporal and spatial scales in adaptation strategies, to acknowledge and to mediate between different types of knowledge (expert and local knowledge), and to achieve improved integration of different types of measures, tools and norm systems (in particular between formal and informal approaches).

**Keywords:** Climate change, Adaptation, Strategies, Uganda

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## **Studying indicator parameters of ecological tolerance of trees under conditions of the city of Yerevan**

*Gayane Nersisyan \**

*Center for Ecological-Noosphere Studies of the National Academy of Sciences of the Republic of Armenia*

An essential factor to the health and security of urban population is availability of green zones. Scientifically grounded urban greening both assures ecological tolerance, longevity and a functional use of green plantations and is the most productive and cost effective method of urban environment quality management. In recent years, the ecosystems of Armenia's cities emphasizing the capital city of Yerevan displayed high concentrations of diverse toxicants which have a negative impact upon plantations. One should also stress dramatic reduction of green zone areas and deterioration of condition of plants. In this respect, researches aiming indication of ecological tolerance and metabolic specificity of plants under urban conditions have been acquiring a special value. The research goal was studying indicator parameters of ecological tolerance of trees and selection of tree species with phytofiltration properties appropriate for Yerevan greening. The research materials were soils, and basic tree species growing in 10 parks and squares and 20 streets throughout the city. The research was implemented between 2005 and 2017 and included field and lab investigations. The obtained research outcomes allow providing ecological assessment and tolerance of Yerevan street and park tree species, concluding indicating sites with highest chlorine and heavy metal pollution levels, exploration of accumulation properties of plants, studies of the impact of toxicants upon several physiologo-biochemical indices emphasizing nitric metabolism of plants, selection of eco-biochemical criteria for indication of ecological tolerance of plant species and description of urban sites pollution levels.

**Keywords:** Urban greening, trees, soil, heavy metals, phytofilter

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## PS 2.4: Changing Benefits – *Chaired by Luiz da Lima Pedreira*

### **Changing Global Urban Tree Cover and Benefits**

*David J. Nowak, Eric J. Greenfield*

### **Effect of heavy pruning on tree growth and physiology and on microclimate conditions**

*Ferrini F., S. Orlandini, M. Napoli, L. Massetti, M. Petralli, P. Frangi, A. Fini*

### **Using the vitality class approach for the study of the status and condition of street trees in tropical cities. The case of Guayaquil, Ecuador.**

*Gina Serrano, Andreas Roloff, Jame Pérez*

### **Urban residents' favourite and disliked trees in eleven towns in Zimbabwe and South Africa**

*Charlie Shackleton*

### **Financing the Urban Forest, a San Francisco Success Story**

*Carla Shor*

### **The contribution of peri-urban forests to the circular bioeconomy: the case study of Monte Morello in Italy**

*Elisa Pieratti, Alessandro Paletto, Isabella De Meo*

### **Ecosystem services and benefits of Urban Forest and Green Infrastructure in the urban rural divide**

*Assennato F., Di Leginio M., Munafò M., Soraci M., Strollo A.*

## Changing Global Urban Tree Cover and Benefits

*David J. Nowak\*, Eric J. Greenfield*  
*USDA Forest Service*

Urban forests are constantly changing and consequently so are forest benefits and values. A recent study in the United States showed that between c. 2009-2014, US urban tree cover dropped from 40.4% to 39.4% while impervious cover increased from 25.6% to 26.6%. This change equated to a national loss of 55,800 hectares of urban tree cover per year (~28.5 million trees/year) and a loss of urban forest benefits conservatively estimated at \$96 million per year. However, urban tree cover and tree cover change are currently unknown at the global scale. This presentation will display results from a global assessment of urban tree cover that quantifies how urban tree cover and recent urban tree cover change varies among continents and generalized biomes (i.e., forest, grassland, deserts). In addition, a corresponding change in forest benefit values will also be estimated globally. These estimates will be based photo-interpretation of tree cover change from across the world using a random sample of approximately 8000 paired points.

**Keywords:** urban tree cover change, ecosystem services, global variation

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# Effect of heavy pruning on tree growth and physiology and on microclimate conditions

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Urban trees provide many benefits in terms of thermal comfort and Urban Heat Island (UHI) mitigation during the summer season. These benefits are strictly linked to tree canopy, but the management of the trees in the urban environment includes pruning activities. The aim of this research is to evaluate the effects of topping on plant growth and physiology and on microclimate conditions. We hypothesized that topping can affect temperature of air and soil and air relative humidity. Thus, we tested the hypothesis that topping does not only depress tree health and negatively affect physiology, but also directly reduces thermal comfort and human wellbeing in cities. The experiment is carried out using 96 15-year-old maple (*Acer* spp.) and linden (*Tilia* spp.) trees. Half of them were topped in late winter 2017, while the remaining half was left left unpruned, according to a randomized block statistical design with four replicates. Sensors for measuring air temperature and relative humidity during the summer season have been placed in early summer 2016 in the area of research. After topping, tree growth and physiology have been checked, and air and soil temperature and air relative humidity have been continuously monitored for the whole season and the effect on human comfort have been calculated by applying biometeorological indices.

**Keywords:** Urban heat island, photosynthesis, maple, linden

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## Using the vitality class approach for the study of the status and condition of street trees in tropical cities. The case of Guayaquil, Ecuador.

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*Botanical Garden of Guayaquil*

Urban Forests are a significant resource, which can improve the quality of life in the cities when sustainably managed. Street trees, as one of the components of the urban forest, have the potential of being a source of spillover benefits across different land uses of the cities. Thus, in the pursuit of increasing the street trees benefits, the state and the composition are key factors to secure a healthy resource. In Guayaquil, the most populous city in Ecuador, the lack of quantity and quality knowledge of the street trees constitutes an impediment to an accurate management. This research sought to primarily evaluate the status and condition of the street trees of Guayaquil, to further determine which tree species are more suitable for the arduous environment that streets represent to trees. As a starting point, an inventory was created with the help of the Urban Tree Register from the Forest Botany of TU Dresden. Among the variables that were collected are tree species, DBH and height; as well as variables that were collected by using the method of Visual Tree Assessment to diagnose the vitality of trees. The analysis was complemented by including the human population density and a descriptive analysis of each site as a possible reason on the status and conditions of the surveyed trees. As a result, only five tree species were found with a significant number of individuals to perform statistical analysis to finally determine the tree species with the best condition. The presence of the results accounts for a conjugation of factors that, together with recommendations, seeks to help the planning and management of the street trees of Guayaquil.

**Keywords:** Street trees. Vitality class. Visual Tree Assessment. Urban Forest. Tropical cities.

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# Urban residents' favourite and disliked trees in eleven towns in Zimbabwe and South Africa

Charlie Shackleton\*

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Local participation has been repeatedly identified as a core necessity in designing and offering urban tree programmes that will be sustainable because they meet local aspirations and needs. However, it is often limited in both developed and developing world contexts. This paper reports on a survey in eleven towns across Zimbabwe and northern and south-eastern South Africa regarding urban residents' favourite tree and the reasons for that, along with disliked trees and the associated reasons. There were approximately 100 respondents per town, evenly divided between the CBD, poor and affluent areas. Across the 11 towns, residents listed 59 tree species, with Jacaranda, Mango, Baobab, Mopani and Sweethorn as the most mentioned; however, given the large geographic spread of the sample there were marked regional differences. The five most common reasons for preferring a particular species were tasty fruits (19.2 % of responses), reminding the respondent of where they grew up (18.6 %), large size (15.3 %), shade provision (13.3 %) and beautiful form or flowers (7.6 %), but regional differences were strongly evident, such as the high rating given to cultural values and species in south-eastern South Africa, or providing habitat for edible caterpillars in Zimbabwe. Twenty-nine species were mentioned as disliked by some respondents, with the most common reasons being that the species is thorny (26.2 %), it creates a mess by dropping lots of leaves or flowers (15.7 %), it causes allergies (14.8 %) or it is poisonous (14.4 %). Females were more likely to list a disliked tree than males. Other response patterns with socioeconomic attributes will be presented. This information can be useful in guiding public space tree planting programmes at regional levels.

**Key words:** Disliked tree; Favourite tree; Southern Africa; Tree attributes; Urban residents

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## **Financing the Urban Forest, a San Francisco Success Story**

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The session will cover the successful collaboration of planning, finance, advocacy, and delivery of urban infrastructure through a robust planning and community organization process. Due, in part, to declining city funds for the maintenance of San Francisco, the City was experiencing an increasing street tree mortality rate. The decline in available funds compelled the City to relinquish maintenance responsibility of street trees to property owners. During this funding crisis, the Planning Department recognized the social, environmental, and economic value of the urban forest and initiated an Urban Forest Master Plan: Street Trees. The early formulation of the plan led to a successful collaboration of San Francisco Public Works, Planning Department, and the Friends of the Urban Forest to find a sustainable funding source and operation plan for the expansion and maintenance of this critical citywide asset. This session will discuss the early planning process, financing strategy, stakeholder engagement, and the 11th hour roller coaster ride that ultimately ended in the successful long-term set-aside of \$19 million a year towards the ongoing maintenance and expansion of San Francisco's street trees. It will discuss the multi-stakeholder collaboration combined with robust planning and economics that led to a replicable method for urban infrastructure initiatives. This session will discuss the lessons learned, the 4-year road to approval, and the new challenges resulting from a successful campaign to grow and maintain San Francisco's urban forest. Measure E passed by over 75% of voters to set-aside \$19M a year for street trees in November 2016.

**Key words:** street trees, urban forest plan, financing, multi-stakeholder collaboration, maintenance

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## The contribution of peri-urban forests to the circular bioeconomy: the case study of Monte Morello in Italy

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The circular bioeconomy – defined as integration of the peculiarity of bioeconomy in the definition of circular economy – is considered a key concept to increase the competitiveness of enterprises and economic of European Union (EU) member countries. According to the EU Bioeconomy Strategy, the bioeconomy sectors in EU members countries are worth 2 trillion € in annual turnover and account for more than 22 million jobs (around 9% of the workforce). In the ambit of circular bioeconomy, forest sector has a key role with special regard to the bioenergy production. The main aim of the present study is to analyze the role of urban and peri-urban forests in the context of circular bioeconomy. From the methodological point of view, the forest-wood chain in a case study in Italy was analyzed following the circular bioeconomy approach and using a multiple-criteria decision analysis (MCDA), that allows comparison of ecological objectives with socio-cultural and economic ones, by means of a structured and shared framework. The study was conducted in LIFE14 CCM/IT/905 (FoResMit) project in the Monte Morello peri-urban forests in Florence province. The study was divided in two steps: 1) in the first step materials flow (timber and wood biomass for energy use) and carbon dioxide emission of productive process were analyzed; 2) in the second step a set of indicators – specific for the forest sector – to quantify the 4R (Reduce, Reuse, Recycle, Recover) of circular bioeconomy was identified and tested in Monte Morello peri-urban forest. The indicators have been used to perform the MCDA by means of multi-attribute value theory (MAVT) approach. In particular, in this study the following aspects were considered: improvement of production process efficiency in term of economic value (economic sustainability) and of reduction of carbon dioxide emission (environmental sustainability); reuse and lifetime of wood products; optimization of potential wood assortments; and energy recover from the wood products. The results of present study show that forest-wood chain by thinning in Monte Morello peri-urban forest has not optimized the commercial wood assortments because all wood volume was allocated for bioenergy production. This aspect has generated a negative economic impact and reduced the lifetime of wood products. Conversely, the results show a positive balance regard to the carbon dioxide emission and for the energy enhancement of deadwood stock of the Monte Morello peri-urban forest.

**Keywords:** circular bioeconomy, forest-wood chain analysis, woodchips, set of indicators, MCDA (Multiple-criteria decision analysis)

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## **Ecosystem services and benefits of Urban Forest and Green Infrastructure in the urban rural divide**

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*ISPRA (Italian National Institute for Environmental Protection and Research)*

Following the European Strategy for Biodiversity Conservation 2020 promoted by the EU, it is clear the importance of containing as much as possible the consumption of agriculture and natural soil due to artificial land cover and soil sealing growth (land consumption). This is one of the main causes of degradation of natural habitats and loss of ecosystem functions, that is neither properly integrated into our economic and social systems nor our decision-making processes. The concept of Ecosystem Service (ES) and benefits of Urban Forest (UF) and Green Infrastructure (GI) is becoming more crucial both globally, and, more recently, at the regional, national and local scale. In particular, soil-related ecosystem services are acquiring visibility as an instrument to improve awareness and decision making in terms of sustainable use of soils and to highlight rural-urban interaction. Since 2016, ISPRA and the Italian National System for the Protection of the Environment (SNPA) together with land consumption monitoring, perform an assessment of variation produced by land consumption on ten soil-related ES (Carbon Storage and Sequestration, Habitat Quality, Crop Production, Timber Production, Water Purification, Erosion Protection, Pollination, Water Infiltration, Microclimate Regulation, Particulate and Ozone Removal) in a national report. The analysis is based on changes in land consumption revealed by the National map of land consumption improved by ISPRA integrated with Copernicus High Resolution Layers (HRL) and the Corine Land Cover (CLC). Biophysical and economic assessment of services variations produced by soil consumption is performed using GIS based models, InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) or other available methodologies. Results of ecosystem services variations related to 2012-2017 land consumption changes in Italy are presented in this report.

**Keywords:** ecosystem services, soil sealing, land consumption, land cover

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## **Parallel Session 3 – The Present (2)**

## PS 3.1: Changing People – *Chaired by Terry Hartig*

### **Status of fringe forest management in rainfed areas of India and socio-economic assessment of fringe villages for Rural-Urban areas**

*Neelesh Yadav, Zenab Akhtar, Geeta Kohli*

### **Collecting and Sharing Global Stewardship Stories**

*Erika Svendsen, Lindsay Campbell, Michelle Johnson, Laura Landau, Jennifer Smith*

### **Modelling the Effect of Tree Planting on Mitigating Heat Exposure for Vulnerable Population in Australian Cities**

*Sun Qian Chayn, Amati Marco, Boruff Bryan J, Hurley Joe*

### **The Natural Health Service in The Mersey Forest**

*Clare Olver, Lisa Newson, Zoe Knowles*

### **Integrated approaches to urban and rural community forestry**

*Ian Whitehead*

### **REBUS® [REnovation of public Buildings and Urban Spaces ]: a method for designing resilient cities by implementing Nature based Solutions**

*Luisa Ravanello*

### **The barriers to, and enablers of tree planting in South African low-cost housing suburbs**

*Gwedla, Shackleton, Olvitt*

### **Cooperation between policymakers, stakeholders and the public: Citizens participation on the example of the EU Project "Smarter Together" and "Freiham" in the City of Munich, Germany**

*Anna Steidle*



## **Status of fringe forest management in rainfed areas of India and socio-economic assessment of fringe villages for Rural-Urban areas**

*Neelesh Yadav\*, Zenab Akhtar, Geeta Kohli  
Forest Research Institute Dehradunh*

Fringe forest near the rural – urban areas plays an important role for agriculture productivity as well as for cooling temperature in summer, for reducing the chill of winter winds, to clean the air, to reduce noise, and provide a home for birds. In India the percentage of urban forest comes under tree outside forest (TOF) category and it define as trees growing outside recorded forest areas. The study of fringe forest management in rainfed areas of India and socio-economic assessment of fringe villages was carried out during year 2012 to 2017 across India by Forest Research Institute Dehradun. Looking at the needs of forest managers to track the changing patterns of dependence and the social attributes effecting demands of adjoining fringe communities, Forest Research Institute undertook and completed the present study in selected 275 rainfed districts spread in 27 states and 1 union territory of India to assess the status of the fringe forest and reliance of forest fringe communities on the forest. The need of green infrastructure development in UPF domain may be adopt as per the study carried out in the fringe forest villages and results and data generated through this study. The study will assist for policy makers to take decisions for changing the socio-economic status of people living there. In majority of the forest fringe villages, communities have high dependency on the forest for fodder, livestock grazing, fuel wood, and NWFPs. In spite of all tall claims by various agencies, the forest are still degrading (and also depleting) primarily due to over exploitation, which needs to be reversed for sustainable forest management. There is need to formulate the revised policies for enhancement of forest areas between urban and rural fringe, so that urban forestry may be sustain for future.

**Keywords:** Forest Fringe, Forest fringe villages, Rainfed area, Urban Forest

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## Collecting and Sharing Global Stewardship Stories

*Erika Svendsen\*, Lindsay Campbell, Michelle Johnson, Laura Landau, Jennifer Smith*  
*U.S. Forest Service--New York City Urban Field Station*

Background: Over the past year, NYC Urban Field Station (UFS) staff created and implemented a “Stewardship Story Mapping” exercise to engage the public as stewards of natural resources. Our prototype activity was developed in collaboration with the artist Carmen Bouyer. The activity asks participants to think of a time when they engaged with the local environment through conservation, management, monitoring, transformation, education, and/or advocacy and to turn this act into a story or illustration. These stories and images are placed on a map of New York City on or near the location where they took place, resulting in a snapshot of the stewardship landscape for the group. If an individual has a hard time thinking of an example, they can flip through stewardship card decks to get inspired. Youth may choose to draw instead of write. To date, this activity has been run ten times, reaching approximately 500 members of the public, with participants of all ages and backgrounds. It was also used at the New York State ReLeaf conference in a presentation setting with urban forestry professionals, who shared their stories verbally before adding them to the map - and we found it elicited detailed examples that get to the heart of why we engage in this important work, demonstrating clearly the importance of stewardship. Proposal: This exercise can be expanded and built upon for a global audience at the World Forum on Urban Forests. Because of its flexibility and inclusive approach, the audience for this work can be both the official participants in the meeting (elected officials, NGOs, research scientists, urban forestry professionals) as well as the general public from the broader Mantova community. Format: An interactive discussion where participants can share their own stories of when they “took care of the environment in their own neighborhood/hometown/city.”

**Key words:** Stewardship, Networks, Mapping, Community Engagement

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# Modelling the Effect of Tree Planting on Mitigating Heat Exposure for Vulnerable Population in Australian Cities

*Sun, Qian Chayn\*, Amati Marco, Boruff Bryan J; Hurley Joe*

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*2. CAUL (Clear Air and Urban Landscape) Hub, Australia*

*3. University of Western Australia, Perth, Australia*

Hot weather is a threat to human health, particularly for vulnerable populations, such as older or very young people in cities. Increased vegetation can help reduce temperatures and exposure to heat hazards. The spatial heterogeneity of heat-related diseases suggests that interventions (e.g. tree planting) should be targeted for maximum impact. Analysing heat vulnerability for communities offers opportunities for presenting information to support decision-making. The objectives of this study are to: first investigate the associations between land surface temperature (LST), tree canopy cover and community population profiles using satellite-derived temperature and census data in Melbourne, Australia; second identify the spatial variations of heat exposure for vulnerable population; and last model the effect of increasing tree canopy cover on the vulnerable populations. Geographically Weighted Regression (GWR) was used to explore the LST-Tree-Population relationships and map the distribution of heat-vulnerable populations. The findings warn against the simplistic use of global spatial or statistical analysis on available data to target areas for interventions. The approach enables local governments to identify hot spots of vulnerability increase urban vegetation, and allocate resources to people in critical areas.

**Keywords:** heat-tree-health intervention; land surface temperature; vulnerable populations; Urban Heat Islands; Geographically Weighted Regression (GWR)

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## The Natural Health Service in The Mersey Forest

*Clare Olver\*, Lisa Newson, Zoe Knowles*

*The Mersey Forest; Liverpool John Moores University; Liverpool*

The Mersey Forest is a growing network of woodlands and green spaces in North West England, home to 1.7 million people, which has been creating “woodlands on your doorstep” for nearly 25 years. The Natural Health Service programme builds on an increasing body of evidence which shows that engagement with the natural environment has a positive effect on physical and mental health. It identifies and utilises the unique features of woodlands to tackle health inequalities by empowering and encouraging targeted populations to adopt a preventive, self-care approach to health. The programme provides five different evidence-based activities from group walking to mindfulness, all taking place in a wooded therapeutic environment. The weekly sessions are targeted both adults and children and designed to be welcoming to beginners. Working in conjunction with the Natural Health Service ‘Centre of Excellence’, which includes both the University of Liverpool and Liverpool John Moores University, all activities are academically evaluated. Data is gathered for measuring changes in physical activity and mental wellbeing. Over 1,750 participants have taken part since 2016 and preliminary results show significant increases in both physical and mental wellbeing, including a 12% increase in wellbeing and 48% increase in moderate physical activity. A study on the activity levels of school children showed that levels of physical activity on Forest School days were equivalent to those when they took part in physical education (PE) days, with both showing statistically significant increases in physical activity over non-PE days. Further analysis showed that children with a body mass index of over 25, both male and female, showed the greatest level of physical activity increase in Forest School days. The programme continues to develop to make the most use of the maturing woodland assets within The Mersey Forest.

**Keywords:** wellbeing; activity; Forest School; inequality;

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# **Integrated approaches to urban and rural community forestry**

*Ian Whitehead\**

*Institute for Landscape Architecture, RWTH, University of Aachen*

Approaches to citizen participation and governance in the planning and delivery of participatory forestry have followed different paths across urban, peri-urban and rural areas of NW Europe. We have tended to differentiate between urban and rural approaches rather than looking at synergies occurring at regional level. Within urban and peri-urban areas, top-down agency or local authority led programmes have been emphasised whilst more enabling, community based approaches are often more characteristic of smaller communities. Considerable geographical variation also occurs on a larger scale concerning the approaches existing across countries and regions. To deliver effective Green Infrastructure (GI), it is increasingly recognised that action must be considered and implemented on a landscape scale, taking into account the complex relationships existing between cities and their hinterlands. This presents practical challenges in terms of how we might reconcile and integrate bottom-up participatory approaches within the context of a holistic vision for GI. Using examples of participative forestry from the Aachen City Region of Germany and Central Scotland, the potential for knowledge sharing between urban based approaches and those adopted within smaller communities will be evaluated along with consideration of how these fit within a wider, coherent vision for GI. Whilst urban initiatives often highlight innovation and radicalism, they raise longer term questions of ongoing sustainability and the need for ongoing mentoring and support. By contrast, initiatives associated with smaller settlements are often more focused in scope, being driven by immediate concerns such as local pride or generating inward investment. Such projects however, often benefit from higher levels of social capacity and a self-help ethos existing within rural areas. This has accelerated a trend towards co-management and community ownership, especially within the Scottish context. There are also lessons to be considered regarding the role and effectiveness of mentoring organisations including statutory authorities and NGOs.

**Keywords:** Community forestry, Green infrastructure

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## **REBUS® [REnovation of public Buildings and Urban Spaces ]: a method for designing resilient cities by implementing Nature based Solutions**

*Luisa Ravanello\**

*REBUS project manager at Regione Emilia-Romagna*

Since 2015, Emilia-Romagna Region is experimenting a method for designing public spaces for climate proofing and urban comfort, health, well being and safety of city dwellers. REBUS® focuses on Nature based Solutions (NbS) for urban heat island and heat waves effects mitigation and sustainable urban rainwaters management. REBUS®, which includes seminars and interdisciplinary design workshops conducted with the gaming simulation method, has led to many important results at both local and regional administration levels: an awareness enhancement of public officials, administrators and professionals on the need of climate proofing and related issues (citizen welfare, safety and health); a specific training on NbS to combat the harmful effects of climate change through the design of Green and Blue Infrastructure;

- consolidation and dissemination of working methods in interdisciplinary teams (architects, landscape architects, urban planners, civil engineers, hydraulic engineers, agronomists and forestry engineers, etc.);
- a greater cross-sectoral approach in local administrations while planning and designing public spaces;
- an interdisciplinary approach in calls for tenders for public spaces design proposal;
- an important fallout in terms of policy implementation in the new regional urban planning law 24/2017 which assigns an important role to urban forestry and green infrastructures as equipments for urban and ecological-environmental quality strategy.

More than 3 years of REBUS® dissemination activities:

- 6 Emilia-Romagna Region provincial capitals involved;
- 200 officials and professional involved in the design workshops, working in interdisciplinary teams (16 each team)
- more than 2000 persons among public administrators, officials, professionals, academics, students, etc. trained and or met during seminars and dissemination activities.

**Keywords:** Resilient cities, Public Spaces, Climate mitigation and adaptation, Green and Blu Infrastrutture

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# **The barriers to, and enablers of tree planting in South African low-cost housing suburbs**

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South Africa has a noticeable absence of trees in public spaces in government planned low cost housing (LCH) areas. This study sought to examine the barriers to, and enablers of tree planting in the public and private space of these LCH suburbs. Eight hundred households in new and old LCH suburbs in eight small-medium sized towns were interviewed, along with key-informant interviews with responsible municipal officials. On observation, there was clear absence of trees in the public spaces of the sampled suburbs. In the private space, 52 % of households had at least one tree, with more households in older LCH suburbs having trees than newer ones. Different barriers and solutions to tree planting in relation to the public and private spaces were identified by residents and municipal officials. For public spaces, residents felt that “municipal incompetence” was hindering tree planting, while municipal officials attributed absence of trees to a lack of funds. Residents perceived a lack of space as a major barrier to tree planting in private spaces, while municipal officials perceived a lack of financial resources as a constraint. According to residents, municipal intervention through channelling resources towards tree planting programmes that enlist the variety of skills held by community members would be a feasible strategy for public space greening. Additionally, municipal officials suggested that amendments to municipal Environmental Management Plans, and overall institutional functioning of various departments, could be a solution. Residents felt that availability of financial resources could accelerate tree planting in private spaces, while municipal officials suggested that changes in residents’ attitudes towards urban trees could enable tree planting. An implementation of any of the suggested solutions requires holistic engagement between community members, municipal departments, non-government organisations, and all affected stakeholders.

**Keywords:** Barriers, Enablers, Low-cost housing areas, South Africa, Tree planting

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# **Cooperation between policymakers, stakeholders and the public: Citizens participation on the example of the EU Project "Smarter Together" and "Freiham" in the City of Munich/Germany**

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World is changing and urban areas are changing. Meanwhile this urban transition is a common knowledge. However, to make the urban transition sustainable the cooperation of policymakers, stakeholders and the public is required. Professional circles (e.g. City Planners, Landscape Architects, Urban Foresters) all over the world are looking to the City of Munich/Germany where (among others) two projects of urban transition are just in the focus. One project is "Smarter Together". The EU Commission has chosen Munich, Lyon and Vienna to pilot ground-breaking smart city solutions. It is turning Munich into a laboratory for the European city of the future, as local government collaborates closely with numerous partners in the business and academic communities. The other project is "Freiham" in the west of Munich. More than 20,000 people will live in Freiham, many thousands will work, shop, learn, play and spend their free time here. On 350 hectares of open space, a new urban district was planned the size of a small town. The research project will answer the question: What do citizens living in the area know about the projects? How could citizens' participation be improved in order to increase the acceptance of both projects? What can we learn for the future to increase the cooperation between policymakers, stakeholders and the public? "Freiham" and "Smarter Together" will last far into the next decade, therefore the process is evaluated during this time with methods of qualitative social research (e.g. Interviews, Analysis of Documents to which inhabitants has access, Analysis of Social Media Networks, both under application of the method of Grounded Theory). First results show that the cooperation between the policymakers, stakeholders and the public is poor. Although there is a lot of citizens' participation, the concerns of people living in the area are not taken serious, at least people do not feel to be taken serious. This could be a risk for the acceptance and the implementation of the whole process. Other results and observation will be presented with the hope to improve the citizens' participation in other projects of urban transition.

**Keywords:** Urban Transition, Citizens participation, Integration of Stakeholders, Acceptance of Urban transition, Stakeholders

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## PS 3.2: Green Spaces and Places – *Chaired by Marco Cillis*

**How urban dwellers identify with natural elements within urban green spaces in the Eastern Cape, South Africa?**

*Amanda Manyani*

**How ecosystem services provided by urban green spaces change according to new city planning strategies? The case study of Berlin**

*Rocco Pace*

**Productive Green Roofs as a multi benefit tool for Cairo's informal settlements**

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**Norwegian urban green space management - Managers' perspectives**

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**Urban forests: Sharing a common language of holistic stewardship**

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**Measuring for Managing the Urban Green Blue Infrastructure. An International survey of building Resilience in Cities**

*Maria-Beatrice Andreucci*

**Cesano Maderno: a decade experience in urban forestry**

*Salvatore Massimo Colombo*

**Breathe spaces – activating natural processes**

*Bernard Koenig, Liza Enzenhofer*

# How urban dwellers identify with natural elements within urban green spaces in the Eastern Cape, South Africa?

*Amanda Manyani*

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Green spaces contain various elements that play a crucial role in supporting urban ecological and social systems. The various natural and artificial elements contained in public urban green spaces are key contributors to the quality of life and well-being of urban dwellers. Yet, this has been largely ignored in urban design in South Africa, especially in the poorer townships. Additionally, most research on the links between nature and human well-being comes from developed world contexts which assume a westernised view of the relationship. Yet, in many societies of the global South, including in South Africa, worldviews and experiences of nature takes on different meanings to those of the global north. A mixed methods approach was employed in this study, with the qualitative aspect covering assessments and evaluation of available elements within public green spaces. A quantitative approach employed use of a household survey of 360 interviews selected purposively because of their location next to the green spaces. Results indicated that, across all the green space types, they were low levels of maintenance, safety, recreational facilities and natural elements. The attributes of these spaces therefore influenced the motives of visitors as more than 90% of the respondents said the dominant motive was passing through whilst the active motives of visiting the spaces were only pursued by a few. With regards to attitudes and preferences towards particular elements, there was an emerging sense of strong negative feelings towards natural features. This suggests that the current design and infrastructural components within the studied urban green spaces does not offer a better well-being and quality of life that other countries enjoy in the developed world. Specifically, the various psychological benefits linked, with being in contact with nature are not attained by people within the low-income areas of the Eastern Cape, South Africa.

**Keywords:** green spaces, natural elements, quality of life

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# How ecosystem services provided by urban green spaces change according to new city planning strategies? The case study of Berlin

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A rising population in cities, elevated temperature and extreme weather events due to climate change, together with high levels of pollutant emissions increase the need for sustainable planning strategies to maintain and improve people's well-being. To reduce emissions and improve air quality, advanced technologies are being advocated, such as electro-mobility or high energy-efficient tools and buildings. On the other hand, green infrastructure has been identified as a means to reduce pollution by deposition. The attractiveness of green areas in cities is further increased by their cooling effect, the possibility to sequester carbon, as well as numerous recreation possibilities. Therefore, plans for increasing green infrastructure are developed or implemented in many cities, which, however, often lack a quantitative understanding of benefits and costs. In order to quantify the effect of different strategies to increase or maintain the urban greens in the city of Berlin, Germany, we evaluated three scenarios in terms of their effect on air pollution: the first focuses on reducing pollution emissions using new technologies (TECH), the second is based on increasing the number of trees (GREEN), and the last one tries to combine both strategies in order to get the same amount of benefits from both (SPLIT). The results demonstrate that more urban trees are a relatively cost-effective measure up until new space has to be exploited for tree plantings. However, since the positive effect on pollution decreases with tree density and can even get negative if airflow is hampered, options to employ this scenario are limited.

**Keywords:** urban trees, pollution, modeling, ecosystem services, scenarios.

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# Productive Green Roofs as a multi benefit tool for Cairo's informal settlements

*Abdallah Tawfic\**

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This paper explores the potential of rooftop farming for the sustainable development of Cairo's poorest neighborhoods. Cairo's fast urban growth over the past few decades has resulted in a deteriorating and defective urban fabric. Massive population growth has led to an increase in unplanned and informal construction, which now constitutes half of Cairo's built-up area. Most commonly established on agricultural land, these informal neighborhoods decrease access to productive urban spaces, while their compact construction pattern generates living conditions marked by pollution and lack of access to open/green spaces. On a national scale, Egypt experiences an exacerbating food security crisis, which calls for smart approaches aiming to increase food production. Urban agriculture has the potential to increase urban green space, improve the quality of urban environments and produce food in previously unproductive spaces. Cities around the world have turned parks, vacant lots and rooftops into urban farms, experimenting with different highly productive growing systems. Studies have shown that urban farming is a resilient strategy that provides multidimensional benefits for urban dwellers. Urban farms improve food security and access to freshly grown food, stimulate local economies and generate jobs, positively impact the environment through increased green spaces, and protect building structures if planned on a roof. They also provide spaces for sports, leisure and community activities and have a positive psychological effect on city dwellers. This paper compares different experiences of urban agriculture and rooftop farming systems implemented in informal neighborhoods of Greater Cairo. It assesses the planning and implementation processes as well as analyzing the different levels of impact such projects can have on poor urban neighborhoods. Using a political ecology approach, this study explores how the organization and management of shared resources depends on local structures of social organization, governance and administration. These factors do not only affect the way the gardens can develop a positive impact on the neighborhood, but also challenge the environmental, social and economic sustainability of the project.

**Key words:** urbanization, informal settlements, urban agriculture, Cairo

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# Norwegian urban green space management - Managers' perspectives

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Urban green spaces have become urban policy tools, providing the basis for quality of life and wellbeing. This resulted in a growing resource availability and attention for the creation of high quality green spaces. Once created, processes that keep quality in green spaces receive little attention. These processes are operationalized in the concept of place-keeping, and understood as 'responsive long-term management which ensures that the social, environmental and economic quality and benefits a place brings can be enjoyed by present and future generations' (Dempsey et al., 2014; p.9). Challenges for long-term management include prioritizing and ensuring the effective provision of quality green space in light of new urban policy focuses, funding constraints, standardized maintenance routines, new public values and new modes of public involvement. In this paper, we establish a baseline of municipal urban green space management, from managers' perspectives, by exploring place-keeping dimensions in Norwegian municipal organisations. The concept assumes that an environment consisting of six dimensions enables long-term management. According to these dimensions, we developed survey questions to assess managers' perceptions of municipal management, with a focus on funding systems, maintenance regimes, partnerships and quality, related to organizational structures and the availability of green space strategies. All Norwegian municipalities (426 (in 2017)) were invited to participate in an online-administered survey in October 2017. A total of 140 responses (34%) were received and included in the analysis. We found that green spaces are perceived to be in medium condition and this will remain the same in the coming three years, but quality has improved in the last three years. Funding relies heavily on municipal tax funding for all municipalities. Alternative funding relies on application systems for additional funding by the state. Integrated municipal units carry out maintenance work, but around 40% collaborate with other non-profit organisations.

**Keywords:** Green space management, place-keeping, quality, green space

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## Urban forests: Sharing a common language of holistic stewardship

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Environmental stewardship is an ancient concept based on the interconnection between humans and nature. This interconnection is enshrined through lifeways, rituals, worldviews, policies, and political acts that guide our interactions with nature through different ways of knowing, being, and behaving. The profession of natural resource management (NRM), represents a formalized type of stewardship in which some of those ways of knowing have become dormant or suppressed. Given the growing pressures NRM agencies face today, stewardship is recognized as critical to sustainability and human well-being, especially in responding to global environmental change and biodiversity. While public agencies and private land owners are well-defined entities, civic groups involved in stewardship are less so. What is civic stewardship and who are the actors involved? Here we explore stewardship from a range of contexts (traditional/indigenous, rural, and urban), scales (from site to community to biosphere), and sectors (public, private, and civic) and events (acute and chronic disturbance). We will discuss how biocultural and urban stewardship relate to urban forestry and natural resource management and propose a shift in as a critical step toward sustainable relationships. Drawing on diverse examples of stewardship from different cities and towns, we describe a holistic stewardship as a way to improve our capacity as a society and sustainable ways of being in the world.

**Keywords:** Environmental stewardship, sustainable development, urban, civic engagement, knowledge systems

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# Measuring for Managing the Urban Green Blue Infrastructure. An International survey of building Resilience in Cities

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The concept of multi-functionality is internationally utilized to emphasize on the many services which Urban Green Blue Infrastructure (UGBI) and, more in general, nature-based solutions display in addition to their prime purposes related to commodity outputs (MEA, 2005). As a result, UGBI is less put into the context of the production of goods, but rather into the context of natural resources' protection, spaces for leisure, education and wellbeing, cultural and heritage landscapes, i.e. Ecosystem Services. The economic implications of the recently emerging "Green Infrastructure" approach are increasingly focusing researchers, policy makers and practitioners' attention from new perspectives, mirroring the needs and claims of the growing population of urban dwellers. Landscape architects, planners, city managers and other practitioners have started incorporating metrics and performance standards as an emerging part of best practice mostly throughout North America and Europe, but also elsewhere. Numerous theoretical and technical tools have been developed to understand different economic valuation aspects and more in general sustainability, adapting methodologies and designing new frameworks, especially in the emerging research area of the Landscape Economy. Better understanding of economic values, associated with design and management strategies and practices, opportunity costs and ecosystem functions and services, enables decision makers and practitioners to successfully engage in trade-off analysis and to identify the potential benefits and losses associated with specific urban landscape governance models. The proposed contribution highlight recent evidence of economic benefits from international UGBI, describing specific applied valuation methods, as well as stakeholders and governance models implemented. In combination with a selected data-base of environmental, social and economic benefits of UGBI, the research aims at encouraging thoughtful discussion and commentary on the fundamental issues those works raise, engaging multiple stakeholders in the sustainable design and management of urban and peri-urban ecosystems and their many valuable goods and services.

**Keywords:** Economic valuation, Ecosystem Services; Landscape Economy; Sustainability assessment; Urban Green Blue Infrastructure.

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## **Cesano Maderno: a decade experience in urban forestry**

*Salvatore Massimo Colombo\**

The "Noi per Cesano" association has been participating for over eleven years with the Municipal Administration of Cesano Maderno (MB) in organizing a Festival of the Tree, also involving local school children. The initiative consists of planting - with urban forestation techniques - municipal public areas. The purposes are redeveloping urban landscape, improving of the local climatic conditions and causing an ecosystem enrichment of the areas involved in these projects. The actions carried out so far on areas owned by the Municipality (often exchanged by private citizen to cover their urbanization costs) were in fact conceived as part of an ecological network system. The aim is to implement in Cesano such interventions that, although addressed to a prevalent function of public use, are consistent with an ecological function of connecting paths (although not continuous, but as "stepping stones"), between the green areas to the west of Cesano, represented by the Groane Park and the Lipu Oasis, and some agricultural areas to the east, included in Brianza Centrale Park. All this with the aim of improving the quality of life of residents in the neighboring areas from the points of view of aesthetic-landscape perception, enjoyment, leisure and cultural growth, as also implemented in the current PRG of Cesano Maderno, which has identified and bound a number of areas aimed at establishing green areas of compensation and landscape redevelopment. So far in Cesano, the Municipal Administration has supported the "Noi per Cesano" association with eleven events since 2006, covering a total area of over 20,000 square meters and with the planting of over 3,000 trees and shrubs of north Italy native species. The participation of the public has always been remarkable, and the first planted areas present themselves today with an interesting tree cover and have taken an important local ecosystem role.

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## Breathe spaces – activating natural processes

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*Breathe Earth Collective*

*Breathe Earth Collective, Think& Do-Tank on AIR, climate and cities. Founded 2015 by Karlheinz Boiger, Lisa Maria Enzenhofer, Andreas Goritschnig, Markus Jeschaunig\*, Bernhard König (Graz/Vienna, Austria).*

[www.breatheearth.net](http://www.breatheearth.net)

Natural processes, atmosphere and climate are a major influence of our living conditions and our social, political and built environment. In the era of the Anthropocene we are facing changing climate conditions, which are affecting our daily lives. These changing conditions are demanding new architectural and urban design models, which integrate natural processes and ecosystemic performance. Breathe Earth Collective will present three of their experimental projects demonstrating the potentials of integrating hybrid landscapes into cities to activate natural processes, increase air quality and design healthy urban conditions. Based on a presentation of three projects, we are going to outline the integral concepts that have been developed within our design practice. By implementing on a larger urban scale they could provide holistic solutions for both - the moderation of the climate in our cities, but also the health of our direct human environments. The first prototypical project to be presented is the Austrian Pavilion at Expo 2015, breathe austria, where our team was in charge from the idea to the design and construction. Breathe.austria sets out explorative issues in dealing with the globally vital nourishment of air and climate. The prototype has united architecture and the environment to create an integral contribution at the Expo in Milan. The second and third projects to be presented are developed in a series of mobile prototypes called “Airship.01 - cultural forest” and “Airship.02 – Evapotree“. The Airship series are mobile breathing spaces which have been presented in Milan, Padua, Rome, Bordeaux and Graz in 2016 - 2017. They showcase hybrid forest installations, which are placed in extreme urban heat islands in public spaces of cities to refresh the citizens in the middle of a forest glade. The performative moss landscapes the Airship.02 purifies the air, cools its environment and creates an atmospheric ,breathing space‘.

**Keywords:** breathe, air, climate, hybrid, prototype

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## PS 3.3: Changing Environment – *Chaired by David Pearlmutter*

### **Porosity of roadside soil as indicator of edaphic quality for tree planting**

*C.Y. Jim*

### **Influence of plant composition and water use strategies on green roof stormwater retention**

*Zheng Zhang*

### **Urban park effects on Naples air quality**

*Emanuele Pallozzi, Gabriele Guidolotti, Michele Mattioni, Corrado Leone, Carlo Calfapietra*

### **Comprehensive assessment of health care function in the typical recreation forests of Hui Mountain in Wuxi City, Jiangsu Province of East China**

*Lin Gu, Cheng Wang, Baoquan Jia, Erfa Qiu, Ruilin Sun, Zhenkai Sun*

### **Sustainable Management of Urban Forests. What is environmental, economic and social sustainability in management of urban open spaces?**

*Thomas B. Randrup, Johan Östberg*

### **When Trees Fail: Bio-mechanical Analyses of Storms in the Caribbean and in N. America**

*Anand Persad*

### **Characteristics of Riparian Vegetation and the Associated Human Influence in urban area**

*Zhang Chang, Wang Cheng, Sun Ruilin, Jin Jiali, Tang Sainan*

### **Mitigating urban climate change - Simulating ecosystem services of urban trees under present and future climate conditions**

*Thomas Rötzer, Astrid Moser, Mohammad Rahman, Stephan Pauleit, Hans Pretzsch*

### **Urbanization and climate change: transition for and transformation of urban forestry in Sri Lanka**

*Mangala De Zoysa\**

# Porosity of roadside soil as indicator of edaphic quality for tree planting

C.Y. Jim\*

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Roadside tree pits commonly suffer from small size, poor soil, and heavy compaction. Their three soil types with different properties, respectively site soil, backfill and rootball, could constrain tree establishment and long-term growth. Sixty-nine soil samples were taken from 19 tree pits, with multiple artificial layers sampled separately, at roadside sites in Hong Kong. They were analyzed for profile characteristics, pH, bulk density and particle-size distributions. Pores were divided by into three classes: (1) unavailable moisture UM at  $<0.2\ \mu\text{m}$  (also known as micro-pores); (2) available water AW at  $0.2\text{--}60\ \mu\text{m}$  (meso-pores); and (3) and air capacity AC at  $>60\ \mu\text{m}$  (macro-pores). Critical pore-volume thresholds, namely extreme, marginal and optimal, assessed soil-porosity quality. Site soils were heavily compacted with  $<40\%$  and  $<30\%$  total porosity, denoting respectively marginal and extreme thresholds, with equivalent to bulk density exceeding  $1.6$  and  $1.9\ \text{Mg/m}^3$ . The upper soil zone was more compacted than middle and lower zones to generate undesirable surface-sealing. Backfill and rootball soils had less stressful porosity and bulk density limitations. Initial tree establishment explored more amenable backfill, but long-term root growth into site soil would be hampered, with implications on tree health and stability. The excessively sandy texture, upon compaction to a certain degree, allowed generation of a continuous coarse matrix. It established inter-granular contacts and high load-bearing capacity to arrest further compaction. AW pores could thus be sustained for available-water storage to support tree growth. The findings could inform porosity specification in urban soil management to foster roadside tree performance.

**Keywords:** Urban soil compaction; Soil quality deficit; Pore size distribution; Critical pore-volume threshold; Continuous coarse matrix principle

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# **Influence of plant composition and water use strategies on green roof stormwater retention**

*Zheng Zhang\**  
*University of Melbourne*

Green roofs are increasingly being considered a promising engineered ecosystem for reducing stormwater runoff. Plants are a critical component of green roofs and it has been suggested that plants with high water use after rainfall, but which are also drought tolerant, can improve rainfall retention on green roofs. However, there is little evidence to show how plants with different water use strategies will affect green roof retention performance, either in monocultures or in mixed plantings. This study tested how monocultures and a mixture of herbaceous species (*Dianella admixta*, *Lomandra longifolia* and *Styphandra glauca*) affected rainfall retention on green roofs. These species were chosen based on their water use strategies and compared with a commonly used succulent species (*Sedum pachyphyllum*) with conservative water use. We measured retention performance for 67 rainfall events, quantifying all components of the water balance. We also compared growth for species in monocultures and mixtures. We found that monocultures of *L. longifolia* had the greatest stormwater retention and ET. Although *S. glauca* has a similar water use strategy to *D. admixta*, it had the lowest stormwater retention and ET. In both the mixture and as a monoculture, *S. glauca* created preferential flow pathways, resulting in lower substrate water contents which reduced ET and therefore rainfall retention. This species also dominated performance of the mixture, such that the mixture had lower ET and retention than all monocultures (except *S. glauca*). We suggest that root traits and their interaction with substrates should be considered alongside water use strategies for rainfall retention on green roofs.

**Keywords:** Rainfall retention; evapotranspiration; water use strategy; ecological function; diversity; monoculture

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## Urban park effects on Naples air quality

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The concentration of primary and secondary pollutants strongly affects the air quality of highly anthropic areas. Urban parks are living systems integrated in these anthropic areas where they can provide several environmental services such as carbon sequestration, regulation of microclimatic conditions, and absorption of air pollutants. The main consequence is the effect on local air quality and thus the improvement of the urban environment and the human health. Despite their importance, experimental sites monitoring trace gases fluxes in these ecosystems are still scarce. Our study in Naples takes advantage of an innovative eddy-covariance (EC) station inside the “Real Bosco di Capodimonte”, a large urban park within the densely populated city of Naples in Italy, to quantify its effects on the local air quality. The site is mainly composed by *Quercus ilex* and meadow areas and equipped with the state of the art to measure the exchange of CO<sub>2</sub>, H<sub>2</sub>O, CH<sub>4</sub>, O<sub>3</sub>, PM and NO<sub>x</sub> by means of EC technique. Results demonstrate that, despite the large amount of carbon released from the residential area around the site, the vegetation of the Capodimonte Park can buffer and offset these carbon losses as well as to play a role in small particle deposition. In addition, our results suggest that trace gas fluxes are affected by park spatial variability, especially because of the gradient between meadow and forest and by the seasonality, highlighting the role of physiological status of the vegetation. Finally, the concurrent measurement of many pollutants fluxes resulted fundamental to better understand the biosphere/atmosphere interactions and the resulting effects of urban green forest on urban air quality and on the citizens' quality of life.

**Keywords:** BVOC, air pollutants, eddy covariance, greenhouse gases, urban forest

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# Comprehensive assessment of health care function in the typical recreation forests of Hui Mountain in Wuxi City, Jiangsu Province of East China

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Urban Forest Research Center of State Forestry Administration, China*

This study investigated the temporal changes of the Air Healthcare Composite Index (AHCI) within three typical recreational forests of Hui Mountain National Forest Park in Wuxi City, in order to provide scientific guidance for the local residents to take forest recreation and development the healthcare function of Hui Mountain National Forest Park. We measured the variation of microclimate, concentrations of negative air ions, biogenic volatile organic compounds (BVOCs) that health-promoting for human, air oxygen content, as well as the concentrations of air particles simultaneously in three typical plantations including *Cinnamomum camphora* (CC) forest, *Pinus elliotii* (PE) forest and *Quercus variabilis* (QV) forest located in Hui Mountain, during the day time (5:00 am - 19:00 pm) in the autumn and winter in 2011, and spring and summer in 2012, then AHCI of Hui Mountain National Forest Park was constructed based on principal component analysis. The results showed that: (1) Seasonal averaged AHCI was the highest in the summer and lowest in the spring. In addition, the highest AHCI in spring, summer and winter, while the lowest within QV forest. (2) The diurnal variation of AHCI in the 3 forests all showed nearly “one vale” in the spring, while changed gradual in summer and autumn. In winter, the diurnal variation of CC forest showed “one peak”, and the other two forests showed “one peak and one vale”. (3) The suggestion was that it suitable for forest recreation in the three forests during 5:00-11:00 am in summer and autumn, however, not be suitable during 5:00-11:00 am in spring nor 5:00-9:00 am and 19:00 pm in winter.

**Keywords:** urban recreational forest, healthcare function, Air Healthcare Composite Index (AHCI), Temporal variation, principal component analysis

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# **Sustainable Management of Urban Forests. What is environmental, economic and social sustainability in management of urban open spaces?**

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Swedish University of Agricultural Sciences*

Since the 1990s, management of urban open spaces, including urban forests has been driven by maintenance manuals introduced as industry standards. These manuals describe how separate objects (e.g., trees) are to be maintained, based primarily on technical measures. Many administrations are now facing the challenge of smaller operational budgets, while requirements concerning social, functional and environmental values are also increasing. There is a need to develop urban forest management so that it is economically efficient and at the same time handles and respects the environmental values of the trees, and ascertain that social and usage values are optimal. This dilemma can be summarized in the concept 'Sustainable Management'. But what is sustainable management, and how can it be described? Urban forest managers from 11 local governments in Sweden and Denmark together with researchers from Swedish University of Agricultural Sciences discussed these questions and came up with a framework during a series of workshops in 2016. The project followed a bottom-up approach where the practical challenges on an object level were identified via a survey. Then, all challenges were analyzed (discussed) from the three sustainability aspects (environmental, economic and social), as well as via the terms / theories of Ecosystem Services and Nature-based Solutions. The project resulted in a framework consisting of an overall management level where six comprehensive sustainability principles were identified. For individual projects sustainability was described in relation to i) materials to be handled, ii) a long term strategy as well as iii) short terms operations. This presentation will present the sustainability framework, and elaborate on the methodology applied as inspiration for further discussions of how to manage and maintain urban open spaces, including urban forests in the future.

**Keywords:** Urban, Management, Sustainability, Strategy, Operations

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# When Trees Fail: Bio-mechanical Analyses of Storms in the Caribbean and in N. America

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Wind events and other natural loading phenomena may affect urban trees to varying degrees. An examination of tree responses to recent natural events in the Caribbean and in north America reveal that trees in our urban spaces are sometimes predisposed to failure. In the Caribbean in surveys conducted in 2016 and 2017, 27 % of failed trees had pre-existing visual defects while 35 % of failed trees had canopies that were asymmetrical (roadside pruned). Stem breakage occurred in trees that were taller than 15 m (70 % of trees that snapped) while trees that failed from windthrow had restricted root spaces (56%) and failure occurred after heavy precipitation (89%). Broken branches on trees accounted for the most frequent incidence of failure with 63 % of managed trees suffering major branch breakage (asymmetrical pruning). In North America, during the same time period observations on trees that failed from wind, snow or ice loading or combination of events in managed settings generally had multiple branch breakage in higher percentage (61% of failure) than complete failure. Visual defects were recorded in 19 % of branch failures. Trees that were managed by regular pruning accounted for 22% of those that had branches that failed. Wind throw was observed in trees that were over 15m in height (80% of the time) with restricted root spaces (87%) and occurred mainly after heavy precipitation (85%). The data suggest that in two distinct environments that trees may fail despite management strategies. Future planning ahead of tree planting to avoid restricted root spaces and asymmetrical canopies etc. may help with tree stability. As we plan our management strategies to align with changing climate, we may sometimes avert failure, however as weather patterns become more 'unseasonable' and erratic, the need to realize optimal tree stability in urban spaces grows.

**Keywords:** Natural Loading, Tree Stability, Failure, Climate

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# Characteristics of Riparian Vegetation and the Associated Human Influence in urban area

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This paper studies 12 major rivers located in urbanization areas in Jinjiang and analyzes various plant characteristics, such as the riparian zone type, spatial extent, diversity and major species, in these areas. Additionally, the urbanization mechanisms that affect these characteristics due to human influence are evaluated. Through data collection based on sample plot surveys, resident interviews and GIS and SPSS analyses, corresponding indexes were adopted for data processing and further analysis. The research results are as follows: (1) riparian zone plants were classified into 70 families, 143 genera and 159 species (plants were divided into 20 families, 30 genera and 41 species; shrubby plants were divided into 15 families, 15 genera and 20 species; and herbaceous plants were divided into 35 families, 98 genera and 98 species). Thus, the plant types and compositions differed considerably in the natural vegetation landscapes of the region; (2) the average width of riparian vegetation zones was smaller than 10% of the total width of riparian zones, the average vertical height of riparian zones was approximately 8.2 m, and planar invasion and vertical stagnation were serious issues; (3) based on the plant formation and species differences at research sites, types of human influence were divided into five classes: aesthetic appreciation, food supply, protective greening, subjective retention and unintentional invasion. The contributions of these classes varied at different river sites; (4) human influence caused changes in the horizontal and vertical distributions of riparian vegetation, which led to changes in plant diversity and affected the overall characteristics of riparian zones in urbanization areas.

**Keywords:** urbanization areas; riparian vegetation; plant characteristics; human influences

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## **Mitigating urban climate change - Simulating ecosystem services of urban trees under present and future climate conditions.**

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Urban trees provide numerous ecosystem services including carbon storage, mitigation of the heat island effect, reduction of rainwater runoff, pollutant filtering, recreation, shading, and cooling. These ecosystem services are often closely associated with the tree species as well as with a tree's age, size, structure and vitality. Moreover, the climate in which the trees grow has strong effects on the benefits trees can provide. To evaluate the ecosystem services of urban trees, a process based growth model was developed which is able to estimate not only biomass growth but also species specific ecosystem services such as carbon storage, transpiration and runoff, shading, and cooling by transpiration. Calibrated with measured data like diameter at breast height, tree height, etc., tree growth of the small-leaved lime, black locust, horse chestnut and plane trees can be calculated for different age classes. The growth model is built up by modules simulating the annual foliage development, photosynthesis, respiration, water balance, and ecosystem services. In a first study tree growth and ecosystem services was simulated for the four tree species in six major cities of Southern Germany under current climate conditions as well for climate scenarios. The results reveal that trees can considerably improve the urban climate and mitigate climate change effects. The dimension of the effects depends on tree species and size as well as on the specific site conditions.

**Keywords:** urban tree growth, ecosystem services, climate change,

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## Urbanization and climate change: transition for and transformation of urban forestry in Sri Lanka

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Rapid urbanization in Sri Lanka shows that 50% of its projected 22 million population expected to be living in cities by 2020. The concept of climate resilient cities is applied on countrywide townships maintaining its ecosystem services and functional integrity. Urban exposure to climate change in Sri Lanka is changing the patterns and ecological consequences of the process of urban forest are in transition. Urbanization and climate change impacts on cities is altering livelihoods strategies and land use practices while demanding: provisioning, regulating, supporting, preserving and cultural services of the ecosystems. Transformation of urban forest on climate change and urbanization is based on ecological, institutional, political, social and economic dimensions in Sri Lanka. Urban forests have a diverse structure where trees are found in stands, arranged in lines along streets, and as single trees. Urban forests are consisted of remnants of native forests and deliberately grown trees with vary in composition, diversity age, health status and ownership patterns. Climate change mitigation and adaptation by urban forests sustain ecosystem services including flood in rainfall intensive areas; carbon sequestration; micro-climate moderation to reduce urban heat island effects; and reduction of GHG emissions from landfills by uptake of wastes for recycling. Biodiversity and conservation planning of urban forests are concerning connectivity of gardens, forest and wild margins in urban landscapes. Urban forests reduce the vulnerability of the urban poor and enhance their coping capacity by reducing the incidence of environmental hazards and creating green jobs.

Sustainable urban forest management integrated into urban planning could play an important role in mitigation and adaptation of climate change impacts in urban areas of Sri Lanka.

**Keywords:** Livelihoods strategies, Land use practices, Forest connectivity

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## PS 3.4: Changing Benefits – *Chaired by Liza Paqueo*

### **Urban Trees as an Upstream Solution to Promote Human Health – A Systematic Review of the Evidence**

*Kathleen L. Wolf, Sharon Lam, Jennifer McKeen, Gregory R.A. Richardson, Matilda van den Bosch, Adrina C. Bardekjian*

### **Ecosystem services from urban green spaces - a quantitative study to compare the species differences at micro-scale**

*Mohammad A. Rahman, Astrid Moser, Thomas Rötzer, Stephan Pauleit*

### **An old resource for new benefits – understanding the role of dead wood**

*Franco Mason, Livia Zapponi*

### **Prioritizing benefits of riparian vegetation in Guangzhou (south China): An importance-performance analysis**

*Wendy Y. Chen*

### **The impacts of green spaces in mitigating the urban heat island - The case of Bengaluru, India**

*Arpit Shah, Amit Garg, Vimal Mishra*

### **Discipline and Impacts of urban forests coping with fine particles and heat waves at Seoul Metropolitan City of Korea**

*Chan Ryul Park, Soyeon Yoo, Namin Koo, Jeonghak Oh, Dohyun Chung*

### **Optimizing urban forest ecosystem services in Medellin, Colombia.**

*Maria Arroyave, Martha Posada, Catalina Londoño*

### **Exploring Insights of Social–Ecological Resilience on Urban Infrastructure Transitions**

*Samuel Ssenyondo, Andrew Ssebudde, Peter Ekwiri*

# Urban Trees as an Upstream Solution to Promote Human Health – A Systematic Review of the Evidence

*Kathleen L. Wolf\*, Sharon Lam, Jennifer McKeen, Gregory R.A. Richardson, Matilda van den Bosch, Adrina C. Bardekjian*

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Cities and countries across the globe must find solutions to address the complex health challenges related to modern lifestyles and changing environments. Upstream interventions can be cost-effective public health actions. Research from around the world reports positive health outcomes associated with urban greening. Trees are a green infrastructure that can be widely distributed across urban landscapes, large and small, public and private. We conducted a systematic review of peer-reviewed articles to analyze associations between city trees and human health. Initial screening of studies published up to March 1, 2018, resulted in 1164 articles; a subset of 199 are being evaluated for the review. Study conditions are defined in multiple ways, for example, streetscapes, single trees, or canopy, or identified by remote sensing techniques (e.g. NDVI and LiDAR). The studies consider a wide array of health outcomes. Nearly 20% addressed air quality and relations to allergy and asthma, with results differing depending on local contexts of roadside screens, woodlands and urban canyons. Other studies of environmental risk addressed heat effects and thermal comfort, ultraviolet exposure and noise attenuation. The most consistently positive results pointed to birth weight effects. Another collection of studies addressed adults and metabolic or physiological outcomes. Mental health and function were also well represented. Fewer studies were found for social dynamics, such as social cohesion and crime. A subset of studies addressed the unequal distribution of urban trees, with fewer trees in disadvantaged communities potentially aggravating health disparities. To our knowledge, this is the first systematic review to focus on urban trees - as opposed to green space or more general nature - as the source of health benefits. This presentation will report the review findings and propose policy recommendations reflecting the evidence concerning the health benefits provided by urban trees.

**Keywords:** public health, literature review, green space, equity, policy

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# Ecosystem services from urban green spaces - a quantitative study to compare the species differences at micro-scale

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Modern cities are affected by the dual threats of ongoing climate change and urbanization to make our cities warmer and greater rainfall runoff. Greening cities, particularly planting trees seems to be one of the most feasible options to mitigate those problems. However, due to high heterogeneity, considerable uncertainty still exists at micro-scales concerning the magnitude, pattern and the process of mitigation by urban greening. We continuously measured eco-physiological and dendrochronological variables; heat fluxes below and above canopy of two contrasting tree species: *Robinia pseudoacacia* and *Tilia cordata* at different street canyons in Munich, Germany since summer 2015. Moreover, we measured the edaphic variables and the soil infiltration across the spatial and temporal scales under the tree canopies. Results showed that within canopy air temperature reduction can be up to 2 °C compared to the reference point and around 1 °C at 1.5 m height from the ground. However, the effect differs significantly depending on tree species and on the paving of surfaces. Anisohydric diffuse porous species – *T. cordata* showed almost three times the transpiration compared to an isohydric ring porous species – *R. pseudoacacia*, correspondingly the air temperature within the canopy boundary layer. *T. cordata* with higher leaf area index and less water using efficiencies, showed higher potential for cooling boundary layer and the underneath paved surfaces. However, *R. pseudoacacia* with more conservative water use, showed better human thermal comfort index due to the evapotranspiration from the underneath grass lawns. Moreover, with 50% higher annual stem growth and fine root biomass, *R. pseudoacacia* also showed significant influence on soil infiltration potential compared to *T. cordata*. The study greatly improved our knowledge of the biophysical control of the whole tree water use hence cooling and surface runoff management in the urban environment to be used in climate and hydrological models.

**Keywords:** climate change, urbanization, eco-physiology, dendrochronology, human thermal comfort

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## **An old resource for new benefits – understanding the role of dead wood**

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Certificazione*

Climate change is expected to tip the balance in the conflict between biodiversity protection and the demand for woody materials towards increased exploitation. Deadwood was historically removed from forests for “hygienic” purposes and/or exploited as fuelwood. However, its role for ecosystem functioning is nowadays supported by several innovative studies. Deadwood represents a vital component for the conservation of forest biodiversity and it is considered a ‘structural legacy’: a long-term source of energy and nutrients that provides critical habitat for a variety of organisms including several red-listed species (Franklin et al 2000). The availability of deadwood, both in terms of volume and diversity, is the key to sustain diverse and structured communities, more resistant disturbances (e.g. pathogen species). Furthermore, it represents a large and long-lasting carbon pool, contributing to nutrient cycling, tree regeneration and a center of intense biogeochemical and physical processes that influence soil functioning (Stutz et al 2017). The presence of deadwood can contribute to enhance the abundance and diversity of the microbial community, with additional fluxes of carbon into the mineral soil (Magnússon et al 2016). Additionally, deadwood influences forest hydrology and geomorphology. It increases the water storage capacity of forests, trapping sediment, controlling water infiltration, stream channel development and hillslope processes (Pypker et al 2011), thus making them more resilient against climate change induced drought situations. As the pressure of biomass extraction for energy production increase, understanding the many-sided contribution of deadwood is crucial to support its sustainable management.

**Key words:** Biodiversity, forest, carbon pool, climate change, sustainable forest management

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# Prioritizing benefits of riparian vegetation in Guangzhou (south China): An importance-performance analysis

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Based on the assumption that satisfaction is resultant from a preference (perceived importance) of a service and relevant judgment of its performance, the importance-performance analysis has been developed and widely utilized to understand customer satisfaction and prioritize provision strategies. Hitherto, little work has been performed to examine whether and to what degree different social groups are satisfied with diverse ecosystem services (benefits) provided by riparian vegetation in highly urbanized areas, as a unique public good. This study pioneers the IPA application to systematically analyze local communities' perceived importance and their perceptions about how well those ecosystem services have been provided by riparian vegetation in Guangzhou (south China). We find notable importance-performance gaps for 10 out of 12 ecosystem services. While all residents could explicitly recognize the importance of these ecosystem services, local residents, in comparison with non-locals, are more dissatisfied with the provision performance due to their stronger place attachment. The enhancement of water purification (using riparian and aquatic plants) should be prioritized, as it is ranked the first amongst all benefits by all respondents, regardless of respondents' hukou status and residing environment. The results provide an accurate picture of actual potentials for the improvement and prioritization of ecosystem services to satisfy respective target groups' needs. The IPA offers a mechanism to help tie local residents' needs with ecosystem services provision, and offers the promise for decision-makers and practitioners to communicate well with different social groups holding diverging expectations and satisfactions, which is essential in order to curate urban green spaces enjoyed and appreciated by diverse social groups via an inclusive urban ecosystem governance.

**Keywords:** Urban riparian vegetation, benefit prioritization, importance-performance analysis, social perception and satisfaction

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# The impacts of green spaces in mitigating the urban heat island - The case of Bengaluru, India

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Rapid unplanned urbanization has created pressures on urban land use in India, leading to deterioration in green cover and an increase in urban temperatures due to the urban heat island (UHI) effect. With India's urban population set to double from 400 Mn in 2011 to 800 Mn by 2050, it becomes critical to understand the role of urban green spaces (UGS) in helping mitigate the UHI effect. Studies on the thermal impacts of UGS in India are limited and have focused mostly on temperature decreases within UGS themselves. In this study, we use high-resolution Landsat and Google Earth data to quantify the cooling effects provided by UGS beyond their boundaries. We integrate remote sensing and spatial statistical analysis to develop a methodology to link land use and temperature patterns at the city level. Our methodology analyses the cooling effects of UGS at two levels - the ward level in a city, and at the level of individual UGS themselves. We plan to demonstrate our method by analyzing data from multiple rapidly growing Indian cities (e.g., Bengaluru, Bhopal). For the case of Bengaluru, we study 22 green spaces to show that UGS can help cool temperatures by  $\sim 1-2^{\circ}\text{C}$  up to distance of  $\sim 250\text{m}$  beyond their boundaries. The cooling effects of UGS increase with their NDVI (Normalized Difference Vegetation Index), size ( $0.5^{\circ}\text{C}/\text{km}^2$ ), and shape index ( $0.7^{\circ}\text{C}/\text{unit}$ ), and decrease with distance ( $-0.7^{\circ}\text{C}/200\text{m}$ ) from the UGS. Our research also demonstrates that smaller green spaces have significant cooling effects. The findings of this study can inform urban land use policy, which is important in the context of India's Smart Cities Mission that has been criticized for an inadequate focus on urban greening. This study also adds to the literature on India by quantifying the role of UGS in localized temperature reduction in urban areas.

**Key words:** urban green spaces; urban heat island; localized temperature reduction; spatial statistics; remote sensing

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## Discipline and Impacts of urban forests coping with fine particles and heat waves at Seoul Metropolitan City of Korea

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Urbanization fragments the green infra and the influx of cool air, accelerating the urban heat island and deteriorating the atmospheric purification function of urban forests. Social concern have been increased on the concentration of fine particles caused by urbanization and industrialization in Korea and China, their values were more than double values of fine particles in Seoul than standard of WHO in 2015. So, we conducted the field survey to know the impacts of urban forests in concentration reduction of fine particles and air temperature under tree canopy of urban forests at Seoul Metropolitan City of Korea. To understand the impacts of urban forests coping with fine particles, we monitored the concentration of fine particles at five minutes interval with the equipment (OSIRIS, Turnkey instrument co.) between the urban area and Hongneung experimental forests from April to November, 2017, and data of wind velocity, wind direction and air temperatures were monitored simultaneously. During high concentration periods (from April to May), PM<sub>10</sub> and PM<sub>2.5</sub> concentrations ( $\mu\text{g}/\text{m}^3/\text{day}$ ) at urban forests were lower as the value of 25.6% and 40.9% than city center, respectively, and for low concentration periods (from June to November) those were lower as the value of 15.3% and 7.9%, respectively. Monitoring of air temperature and analyzing thermal camera at urbans and urban forests showed air temperature ( $^{\circ}\text{C}/\text{day}$ ) of urban forests was lower as  $3^{\circ}\text{C}$  than at urbans. Surface temperature of pedestrian on street under tree canopy was lower as  $2.7^{\circ}\text{C}$  than those on street without trees. At the condition of high land price in Korea, green infrastructure of urban forests in consideration of wind field's connectedness with building infra can be an alternative implementation guideline at Seoul City. In small scale, multi-storied & lined street trees can be a shelter against heat waves at the pedestrian environment of street. Also, we suggest the modified application of the concept of Finger Plan of Copenhagen and Asian traditional Geomancy concept to maintain the sustainable city in a changing environment.

**Keywords:** Fine particles, heave waves, Hongneung experimental forests, Seoul

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## Optimizing urban forest ecosystem services in Medellin, Colombia.

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Urban forests perform different functions that result in the improvement of environmental quality and the well-being of the population. The assessment of urban forest ecosystem serves as a tool for the management of the urban green areas, and as scientific support for the formulation of environmental regulations. The objectives of the project was to quantify the removal of pollutants and carbon by trees in Medellin and its metropolitan area, and to recommend strategies for optimizing those services. The software i-Tree Eco, developed by the USDA Forest Service, was used to assess the structure of the urban forest and quantify ecosystem services. Results reveal: 23% tree cover, removal of pollutants of 228 tons/year, carbon sequestration of 4,700 ton/year, both accounting for a total of 2 million dollars/year. Based on the results, we proposed strategies to optimize the functions of the urban forest and to create mechanisms of compensation for loss of tree cover. The results obtained can be taken into account in regulations related to urban forest management in Medellin, specifically, to calculate the compensatory value of trees. A recent agreement for urban tree management, proposed by the Metropolitan Area Authority, takes into account the economic value of ecosystem services provided by urban trees for the estimation of tree monetary value. The new agreement proposes the payment of a monetary value for those trees that will be felled during the development of infrastructure projects within the urban area. The money collected will be used to create a green fund for planting and taking care of the urban forest. We have proposed to consider the monetary value of pollutant and carbon removal reported in this study to estimate that value. The project constitutes an example of the linkage between environmental regulations and research on urban forestry. Similar studies can be developed in other cities of Colombia and Latin America.

**Keywords:** ecosystem services, pollutant removal, carbon sequestration, urban forest value, urban trees

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# Exploring Insights of Social–Ecological Resilience on Urban Infrastructure Transitions

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**Background:** Sustainable urban development requires providing a healthy and sustainable living environment with basic services for all. A healthy and multifunctional urban green structure is one of the basic services to provide. This article considers the importance of robust planning for green infrastructure in fast changing cities in Uganda. A key theme is the extent to which ecosystem services are valued publicly, and the opportunity costs of not investing in the green infrastructure.

**Methods:** The study explored green infrastructure through pairing insights of social–ecological resilience with perspectives on urban infrastructure transitions. By converging these views, the study showed how green infrastructure can be viewed as an innovative response to challenged urban environments.

**Findings:** Green infrastructure, focusing on the tree-dominated part of urban green space, is a strategic, integrative, interdisciplinary, and participatory approach. Its goal is to sustainably develop the multiple benefits of forests and trees in urban environments. This robust planning strategy for green infrastructure, aims at raising awareness, developing state of the art technologies, generating new technology and knowledge, strengthening institutions and policy, disseminating information and knowledge, and enhancing sustainable urban green infrastructure. Through the Ugandan case study, a number of ecosystem services constitute sources of resilience for an otherwise constrained city. While this is positive and to be valorized, many of Uganda's cities are in the midst of service delivery protests, so that resilient ecosystems, and the citizen networks that sustain these, are largely overlooked in planning processes.

**Conclusion:** A proper understanding of green infrastructure requires blending insights from social–ecological system thinking and infrastructure transition scholarship. Secondly, there is a paucity of knowledge around ecosystem services in Uganda, and that the planning to facilitate ecosystem service valuation is largely inadequate. Lastly, addressing this requires ecosystem valuations relevant to the unique conditions in developing world cities such as cities in Uganda.

**Keywords:** Social, Ecological, Resilience, Urban infrastructure, Uganda

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## **Parallel Session 4 - The Present (3) and Nature Based Solutions**

## PS 4.1: Nature Based Solutions – *Chaired by Thami Croeser*

**Transforming cities, enhancing well-being through nature-based solutions (NBS). The EU-led mission towards the urban green transformation**

*Elisabeth Schmid, Charlotte Michi*

**Nature based solutions to mitigate soil sealing in urban areas: Results from a 6-year study comparing permeable, porous, and impermeable pavements**

*Alessio Fini, Piero Frangi, Jacopo Mori, Cecilia Brunetti, Francesco Ferrini*

**Green infrastructures and associated policies improve urban sustainability: a case study in Melbourne**

*Andrea Pianella, Judy Bush*

**Stormwater management and blue-green infrastructure for improved urban forests. Climate Change Adaptation in Cities - experience from Denmark and Poland**

*Malgorzata Buszko-Briggs, Iwona Wagner, Marzenna Rasmussen, Lars Briggs*

**Urban forest expansion is predicted to reduce the air temperature impacts of urban heat islands**

*Theodore Endreny, Dave Nowak*

## **Transforming cities, enhancing well-being through nature-based solutions (NBS). The EU-led mission towards the urban green transformation**

*Elisabeth Schmid\*, Charlotte Michi  
URBAN GreenUP project*

Cities have become a point of intersection of problems characterized by complexity and uncertainty, among which are the negative effects of climate change, increasing physical and psychological health problems, inequality, alienation, dwindling economic opportunities for many, social fragmentation and conflict. Against this background, NBS are proposed as a unifying concept that could capture both the end goals and the pathways to support transitions to healthy and sustainable communities in urban environments. Introducing nature and natural processes into urban areas not only provide environmental, social and economic benefits but also help build resilience and climate adaptation. Thirteen H2020 European projects have undertaken the complex task of implementing and assessing the effects of these types of solutions. All together they support a network of more than 60 cities and communities in Europe, Asia and Latin America leading the way towards a green urban transformation and climate change mitigation by Nature. Clustering together, representatives from local governments and communities, investors, academia, and industry working in these projects aim at:

- enhancing well-being and inclusion through co-creation and co-implementation
- providing evidence-based and open access knowledge for NBS
- co-producing a monitoring approach for NBS performance
- defining and overcoming barriers (scientific, technical, political, legal, social, economic)
- exploring new business and investment models for large scale deployment of NBS
- promoting the creation of a global NBS market

Case studies experienced in diverse geographical and social contexts will be presented and the signature of a NBS projects' Cooperation Manifesto will be announced. The H2020 cluster's activity has been launched in the framework of the EU Research and Innovation policy agenda on Nature-Based Solutions and Re-Naturing Cities, aiming at positioning the EU as leader in 'Innovating with nature' for more sustainable and resilient societies.

**Keywords:** Nature-based solutions, re-naturing cities, sustainable urbanisation

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## Nature based solutions to mitigate soil sealing in urban areas: Results from a 6-year study comparing permeable, porous, and impermeable pavements

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A long-term research was started in 2011 to evaluate the effects on four different pavement systems on two woody species and on soil physical traits. 48 plants of *Celtis australis* and *Fraxinus ornus* were planted in a 1 m<sup>2</sup> planting pit surrounded by 50 m<sup>2</sup> of: 1- impermeable pavement (asphalt on concrete sub-base); 2- permeable pavement (pavers on a crushed rock sub-base); 3- porous pavement (monolithic porous pavement on a crushed rock sub-base); 4- no pavement (bare soil kept free of weeds by herbicides). Effects of the different pavements on growth and physiology of establishing trees have been described in a previous work. Trees have now fully established, showing most of their roots outside the planting pit, right under the pavements. The presentation will describe the results of the long-term measurements of tree growth (shoot and diameter growth, canopy size), phenology (leaf shedding, dormancy outbreak), and physiology (leaf gas exchange, water relations), which have been carried out on regular basis on 6 replicate trees per treatment. Effects observed on trees have been related to changes induced by pavements on soil characteristics (e.g. oxygen, CO<sub>2</sub>, water availability). Also, interestingly, the effect of pavements on the emission of volatile organic compounds (VOCs) by tree species has been investigated. Results have shown that soil physical traits have been largely affected by impermeable pavements, with a significant reduction of evaporation of water from soil resulting in the onset of a subterranean urban heat island. On the contrary, porous pavements were extremely effective in maintaining soil temperature similar to that of unpaved soil. Furthermore, under impermeable pavements CO<sub>2</sub> accumulates, with negative effects on root activity, but porous pavements can largely mitigate this CO<sub>2</sub> enrichment. Indeed, the effects of the different on growth and physiology of ash and hackberry will be discussed in detail in the presentation.

**Keywords:** *Celtis australis*, *Fraxinus ornus*, Soil CO<sub>2</sub> concentration, Soil moisture, Soil temperature

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# Green infrastructures and associated policies improve urban sustainability: a case study in Melbourne

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Global cities are becoming more crowded and dense, and there is pressure on areas designated for urban parks and green spaces to be replaced with commercial and residential buildings to meet city's growth. As cities lose greenery, their sustainability and liveability decrease, while urban demand for energy and water increases. These demands are pushing scientists, policy makers and practitioners to find prompt solutions to counterbalance the detrimental effects of the rapid urbanisation within and around the city boundaries. As such, practices and policies are being developed to retain and maximise urban greenery and integrate it within buildings. The integration of green infrastructures and renewable applications into building and precinct design is helping to reduce the environmental impacts of urbanisation on people and environment and provide a number of ecosystem services, such as air pollution removal, water and energy reduction, stormwater and urban heat island mitigation, social and recreation provision. Melbourne is considered one of the most liveable cities in the world. In recent years, a number of improvements have been delivered from technical (science) and governmental (policy) perspectives. Water Sensitive Urban Design (WSUD) techniques, such as rain gardens and nature strips, were introduced to reduce stormwater runoff and increase water retention; green infrastructures, such as green roofs, walls and façades, were installed to decrease building energy consumption, mitigate urban heat island effect and provide recreational and social spaces. In this paper, we present and analyse the qualitative and quantitative contributions of these improvements across Melbourne metropolitan areas. We investigate future scenarios on the basis of city policy, planning and development (i.e. Melbourne's Urban Forest Fund, 2020 Vision), and, finally, explore transferability and relevance for other cities.

**Key words:** Green infrastructure; Sustainability; Liveability; Policy; Melbourne.

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# **Stormwater management and blue-green infrastructure for improved urban forests. Climate Change Adaptation in Cities - experience from Denmark and Poland**

*Malgorzata Buszko-Briggs<sup>\*1</sup>, Iwona Wagner<sup>2,3</sup>, Marzenna Rasmussen<sup>4</sup>, Lars Briggs<sup>2,5</sup>*

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Urban forest can provide multiple economic, environmental, and social benefits. At the same time, as part of urban space, they are exposed to progressing urbanization, increased temperature in urban space, fragmentation and isolation, which all result in their increasing vulnerability, loss of biodiversity and decrease of provision of nature's contribution to people (NCP). Additionally, in many areas in the world urban forests turn to be limited by water shortage. Urban drought periods are becoming longer and deeper, resulting from climate change and still prevailing traditional water management, immediately removing stormwater from the city landscape via drainage systems. Such approach reduces the amount of the water available for trees and urban forests, which impacts their growth and health, and ability to cope with the urban stress and climate change impacts. The alternative approach is provided by storing and using stormwater in urban landscape through Nature Based Solutions approach and Blue-Green Infrastructure (BGI) measures, which can substantially improve urban forests and their contribution to resilient cities. This article will present innovative measures from Denmark and Poland on designing and building BGI solutions for handling rain water to prevent flash-flooding and improve urban forests, enhanced by the smart use of biodiversity. Experiences gained within the EU LIFE RADOMCLIMA Project (LIFE14 CCA/PL000101), REALDANIA Innovation project (KLIMASPRING.DK) and EU Horizon 2020 RECONNECT Project "Regenerating ECOSystems with Nature-based solutions for hydro-meteorological risk reduction" will be presented. The measures developed within these projects improve urban space by on-site stormwater retention, infiltration and evaporation, and enhance biodiversity. They offer a powerful tool for local stormwater storage, adaptation to increasing urbanization and climate change pressures. The paper will also present community participatory experiences, which are developed in order to assure long sustainability of the project ecological effects through awareness raising, institutional capacity building and strategic planning exercises.

**Key words:** Urban forest, water, climate change, Nature Based Solutions, Blue-Green Infrastructure

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# Urban forest expansion is predicted to reduce the air temperature impacts of urban heat islands

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Urban forests in megacities reduce extreme air temperatures through transpiration and latent heat of vaporization, and increases in urban forest cover could therefore reduce night time high temperatures and mitigate the human health impacts of urban heat islands. This study quantified the potential reductions in both maximum and minimum diurnal air temperature by existing and potential urban forest cover. Surveys of urban forest cover, and potential urban forest cover, were performed using a systematic photo-interpretation of megacity aerial imagery. Potential urban forest cover could include green infrastructure installations, where trees are strategically located to provide ecosystem services, such as capture stormwater or other benefits. Diurnal maximum and minimum air temperatures were estimated with i-Tree Cool, using a mechanistic simulation of the hydrologic and energy budgets for the urban forest, including interception of precipitation, transpiration of soil water, and partitioning of net radiation into sensible and latent heat fluxes. The study findings show how urban forest cover, potential cover, and benefits of urban forest cooling varies with cultural patterns of development, e.g., urban canyon geometries, and ecosystem biome, e.g., tree physiology and water availability. The benefits of urban forest cooling were quantified using multiple metrics, including sensible heat, sensible heat with humidity in a heat index, cooling degree days, and incidences of heat waves. In addition to the benefits of cooling, the study estimated how urban forest cover contributed to avoided carbon emissions and reductions in additional temperature forcing. An expansion of urban forests is recommended to achieve the maximum benefits from urban forests for reduction of urban heat island impacts. The conservation and expansion of urban forests, including with green infrastructure, are nature based solutions for maintaining urban environments of the future, and are of high priority in our global megacities in order to benefit the greatest number of people.

**Keywords:** urban heat island, urban forest, transpiration, cooling air, megacities

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## PS 4.2: Changing People – *Chaired by Andrej Verlic*

**Town of Victoria Park Urban Forest strategy: a case study of Asset Based Community Development in a volunteer framework**

*Heather Johnstone*

**Risk reduction of vulnerable neighborhoods, foresting hillside slopes in Lima-Peru**

*Josè Sato, Felipe Parado*

**City of Forests, City of Farms: The Governance and Discourse of Urban Sustainability in New York City**

*Lindsay K. Campbell*

**Perspectives on environmental justice in planning and delivery of urban forestry goals**

*Amber Grant, Andrew Millward, Sara Edge*

**Urban forest values recognised in unique legislation**

*David Galwey*

**Ecosystem service provision by urban trees: opportunities and challenges to enhancing delivery through policy and management**

*Kathryn Hand, Kieron Doick*

## **Town of Victoria Park Urban Forest strategy: a case study of Asset Based Community Development in a volunteer framework.**

*Heather Johnstone\**

*Vic Park Collective, Millennium Kids, Vic Park Trees.*

In May 2017, two grassroots community groups, place-makers The Vic Park collective and urban trees advocacy group Vic Park Trees (previously Victoria Park Urban Tree Network), began a partnership with local government authority the Town of Victoria Park. The Urban Forest Strategy Working Group (UFSWG) was born, the intention was to write an Urban Forest Strategy (UFS) using Asset-Based Community Development (ABCD) in a volunteer framework. This presentation explores the challenges, benefits and achievements of this process and makes suggestions to strengthen this model. The Town has undertaken restructuring and extensive community consultation prior to and during the UFSWG's formation and is progressing to a more inclusive and collaborative organisation. The UFS project is both the first Urban forest strategy for the Town and their first ABCD partnership in a volunteer framework to produce a strategy. The success or failure of this endeavour will determine the direction of future ABCD and volunteer partnerships for the Town. The outputs of the project were 5 workshops run in collaboration with the Australian Urban Design Research Center and Millennium Kids, community consultation, developing a strategy to increase canopy to 20% from 10% and a tree planting guide and tree matrix. Promoting the project through print and social media and liaising with a wide variety of stakeholders over twelve months to develop partnerships has involved managing 35 volunteers with a very small budget of \$20,000AUD (€12,500). The strategy has begun final stages with community consultation before council endorsement. Despite challenges and mis-steps the UFSWG has completed tasks and maintained a cordial and professional relationship with Local Government staff and volunteers. This project shows that limited resources with an ABCD approach in a volunteer framework can decrease costs, increase productivity and offer residents a greater sense of ownership of their environment.

**Keyword:** Volunteering, asset based community development, urban forest strategy, community, partnerships

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## **Risk reduction of vulnerable neighborhoods, foresting hillside slopes in Lima-Peru**

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With only 6 mm of rain per year, it is challenging to afforest in Lima, the world's second largest city located in a desert after Cairo. Its steep hills slopes (more than 20°) are being occupied informally, by more than a million people of limited economic resources, who build their homes without proper technique and destabilizing slopes, which puts them at risk in case of the impact of an earthquake or extraordinary rains by the El Niño Phenomenon. Facing this, the "Risk Reduction in vulnerable areas of Independencia district – Lima Province" program executed by PREDES in agreement with the Municipality, with the financial support of USAID/OFDA, implemented the afforestation of 2.5 hectares, with the purpose to stabilize the slopes and control the fall of rocks towards the lower parts where the houses of El Volante II and El Volante III neighborhoods are located. Afforestation is carried out with native tree-plants (molle serrano, tara, etc.) that are adapted to the desert climate of Lima and are more resistant to pests; the use of treated wastewater; drip irrigation; the improvement of soils with compost; and neighbors' participation in the whole process. The Municipality plans to incorporate afforestation at district level, in its proposal for "Sustainable Eco touristic Forest Parks", which considers agronomic and urban-landscape criteria for recreational use as a sustainability strategy, over 50 hectares of hillsides suitable to be forested. This experience of afforestation of hillsides in Lima has been a concurrent factor that has allowed to articulate interests for the environmental quality of the area, ecotourism, land use planning, disaster risk management and mitigation of climate change. See: FAO (2018), *Forests and sustainable cities: Inspiring stories from around the world*. Pp. 15-18, <http://www.fao.org/3/I8838EN/i8838en.pdf> Video (4 minutes): <https://youtu.be/dmWcS8siU04>

**Keywords:** disaster risk management, neighborhood approach, urban resilience

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# City of Forests, City of Farms: The Governance and Discourse of Urban Sustainability in New York City

*Lindsay K. Campbell\**

*USDA Forest Service, Northern Research Station*

This presentation explores how and why urban nature is constructed in New York City using the case of PlaNYC2030—the municipal, long-term sustainability plan launched in 2007. From this entry point, it analyzes sustainability planning as a process that unfolds through the strategic interplay of actors, the deployment of different narrative frames, and the manipulation of the physical environment—including other living, non-human entities. In contrasting the top-down, centralized investment in the urban forest with the decentralized social movement around urban agriculture, the talk traces two very different processes underpinning what sort of nature is produced in the city. PlaNYC launched the MillionTreesNYC campaign, investing over \$400 million in city funds and leveraging a public-private partnership to plant one million trees citywide. Meanwhile, despite the city having a long tradition of community gardening since the fiscal crisis of the 1970s, the plan contained no mention of community gardens or urban farms. Yet public interest in urban agriculture and local food systems has burgeoned, and civic groups and elected officials subsequently crafted a series of visions and plans for local food systems that informed the 2011 update to PlaNYC. Understanding how and why the sustainability agenda is set provides lessons to scholars, policymakers, and activists alike as they engage in the greening of cities.

**Keywords:** sustainability planning, urban forestry, urban agriculture, governance, discourse

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# Perspectives on environmental justice in planning and delivery of urban forestry goals

*Amber Grant\*, Andrew Millward, Sara Edge*

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Urban trees are essential components of green infrastructure and their presence is critically important to urban sustainability. City trees provide a myriad of ecological, social and economic benefits to citizens; however, they are frequently disproportionately distributed across urban neighbourhoods, raising concerns of unequal access for disadvantaged groups. To improve equitable tree canopy cover in cities, many municipalities have developed and implemented urban forest management plans (UFMPs). This research investigates how equity goals and engagement strategies, are perceived and implemented by urban forestry managers, decision-makers and practitioners in forestry departments in San Francisco and Seattle. A range of stakeholders who were directly involved in implementing or influencing UFMPs were engaged through in-person key informant interviews. Interviews attempted to: (1) Better understand how they define or measure equity and justice; (2) Explore their capacity (e.g., knowledge, staff resources, will) to make decisions that support equity and justice goals; and (3) Examine who makes or is consulted on these decisions, and which identities are represented during public consultations. This research focuses on how to implement and realize equity goals in UFMPs, where successful delivery of these goals has broad implications for the sustainability and livability of these cities.

**Key words:** city trees, urban forest management, environmental justice, equity, decision-making

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## Urban forest values recognised in unique legislation

David Galwey\*

*Urban forest values recognised in unique legislation*

To better protect the significant area of urban forest on private land, New South Wales – Australia’s most populous state – enacted legislation to resolve neighbourhood tree disputes: the Trees (Disputes Between Neighbours) Act 2006 (NSW). Importantly, the Trees Act requires the Court to consider the benefits of the tree to the broader community and environment when determining an appropriate outcome. The Trees Act falls within the jurisdiction of a specialised court: the NSW Land and Environment Court, a superior court of record. It provides property owners or occupiers with a means to seek a just, quick and cheap resolution to their dispute. Trees are a major cause of disputes between neighbours in Australia. Trees drop branches and debris, their roots can disrupt structures, and their canopies can obstruct access to sunlight and views. When neighbours cannot resolve disagreements through discussions, or the next step, mediation, they may seek resolution through the courts. Traditionally, tree disputes in Australian courts have been dealt with under the common law torts of nuisance or negligence. In common law, judicial decision makers such as magistrates and judges have considered the impacts of the tree on the aggrieved neighbour, and the onus on the tree’s owner of carrying out any works. As such, little thought need be given to the benefits of trees to the broader community. A significant portion of the urban forest in Australia’s major cities is on privately owned land. Given the numerous economic and social pressures on urban space, and thus vegetation, our policies, and indeed our laws, must reflect the values we now understand are provided by urban forests. In this presentation, I examine the benefits and limitations of this legislation to the urban forest in this jurisdiction, and discuss further possibilities for considering urban forest values in the legal system.

**Key words:** Trees, values, legislation, disputes, courts

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# **Ecosystem service provision by urban trees: opportunities and challenges to enhancing delivery through policy and management**

*Kathryn Hand\*, Kieron Doick  
Forest Research*

Trees provide a range of benefits, or ecosystem services (ES), which help create sustainable, liveable and healthy urban spaces. ES delivery varies between trees depending on factors such as the tree's stature, species, age and condition. However, how a tree is managed can also significantly affect its ability to provide ES. In Great Britain (GB), local governments play a leading role in governing how urban forests are managed. Yet reviews of GB urban forest management identify a lack of long-term, strategic planning and little consideration of the ES provision by urban forests. Changing local government management of urban forests could help to enhance the benefits that urban forests provide. This study aimed to illustrate the direct relation between urban tree management practices and ES delivery, to help inform management approaches that account for ES provision. The study comprised, firstly, an examination of how ES delivery varied with tree species, age and condition using data from over 6000 GB urban trees modelled in i-Tree Eco. This information was used to assess the implications of different management decisions on ES delivery. Secondly, the study sought to understand the context to GB local government management of urban forests. A review of urban tree policies was undertaken to identify the drivers behind current management practises, as well as any targets for the future of the urban forest. Combining these two streams of research provided conclusions that can inform on the relative benefits of the management actions: species selection, planting, management, and tree removal. The study highlighted the drivers that can lead to management actions that are detrimental to urban forest ES delivery, but also identified opportunities to enhance ES delivery by urban forests through improved management strategies.

**Key words:** management, ecosystem service, i-Tree Eco, policy

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## PS 4.3: Changing Spaces and Places – *Chaired by Urmila Rajadhyaksha*

### **Woody Species Diversity and Structure of Urban Forests for Sahel Cities in Niger**

*Moussa Soulé, Boateng Kyereh, Shem Kuyah, Abasse Tougiani, Saadou Mahamane*

### **Redefining Agro-Forestry Settlement Development in Da lat Urban Fringe (Workshop 2018, Da Lat City, Lam Dong Province, Viet Nam)**

*Hai Anh Nguyen, Chau Nguyen Ngoc Minh, Son Tung Nguyen, Anh Khoa Doan*

### **Approach of Online Access to Inventory Data of Urban Trees with ArcGIS (Case of Isparta City)**

*Atila Gul, Emine Keles, Faruk Uzun*

### **California's Urban Forests: Climate Change, Public Health, and Environmental Justice**

*Haydi Boething Danielson, Miranda Hutter, Cindy Blain*

### **The contributions of greenways to people's quality of life – A case study of the Fuzhou Greenway in China**

*Qunyue Liu, Cecil konijnendijk van den Bosch, Qitang Huang, Siren Lana*

### **The architect's wood. Bosco Albergati Park by Cesare Leonardi and the local ecological network**

*Marco Cillis*

# Woody Species Diversity and Structure of Urban Forests for Sahel Cities in Niger

Moussa Soulé<sup>1\*</sup>, Boateng Kyereh<sup>2</sup>, Shem Kuyah<sup>3</sup>, Abasse Tougiani<sup>4</sup>, Saadou Mahamane<sup>5</sup>

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Urbanization in the Sahel is constantly competing with and greatly impacting the woody flora in major cities. Urbanization can replace the species mix, leading to changes in plant community composition; however, there are limited studies that assess these attributes in Sahelian cities. This study assessed the woody species diversity and stand structure of urban forests in Niamey and Maradi. Woody species were inventoried in 363 plots (measuring 50 m x 50 m each) located across six land use and land cover types. Dendrometric variables of woody plants were measured. A total of 4977 individual tree species belonging to 139 woody species (of 41 families) was found in the two cities. A hundred and twelve species belonging to 88 genera with 37 families were inventoried in Niamey while Maradi had 111 species belonging to 37 genera with 34 families. The overall diversity index shows that the urban forest in two cities is rich in species ( $H' = 2.48 \pm 0.56$  bits;  $2.30 \pm 0.87$  bits). The residential urban forests in both cities had the highest Shannon indices. The most dominant families were Fabaceae 24.46 % (34 species) followed by Combretaceae 7.75 % (8 species) and Verbenaceae 7.75 % (8 species). About 52.52 % were exotic while 47.48 % were native. Neem tree was the most abundant woody species in both cities, accounting for 45.85 % of the total number of woody plants encountered. Test of significance between means of diversity indices and growth characteristics did not reveal significant differences within and among the study areas, suggesting similarity of the two floras. The distribution of life form and origin of species is associated with land use in both cities. Based on the findings, it will be more appreciated to continue planting indigenous woody species as well as ex-situ conservation for future programs.

**Keywords:** Biodiversity, Urbanization, Urban trees, Africa

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## **Redefining Agro-Forestry Settlement Development in Da lat Urban Fringe (Workshop 2018, Da Lat City, Lam Dong Province, Viet Nam)**

*Hai Anh Nguyen, Chau Nguyen Ngoc Minh\*, Son Tung Nguyen, Anh Khoa Doan*

In early 2018, investigations were carried out in Dalat to understand existing contexts of forests, potential ecological threats and visions for sustainable development models by Studio Dalat, from the Master of Urbanism and Strategic Planning at KU Leuven, in partnership with Department of Construction of Lam Dong Province; Dalat University; Ho Chi Minh University of Technology; Vietnam National University of Forestry; Ho Chi Minh University of Architecture; Hanoi Architectural University. The context of Dalat highlights its history as a hill station first discovered by the colonial French from late 19th century. Today, it is renowned for seamless integration of tourism, forests and agriculture. “Dalat” translates to “City of a thousand pine trees” in Vietnamese - true to its name, it is filled with them. However, unprecedented urbanization and deforestation of hills are making way to greenhouses – fueling the economy but distorting ecological management. This is despite the successful implementation of PFES and REDD+ since 2004. The 10-day study focused on critical analyses of territories, and 5 grassroots sites for the “Green-Urban-Village-Concept” project. Commissioned by the People Committee of Lam Dong, and the Department of Construction, it raises questions to address issues at stake. This inter-disciplinary think-tank (architecture, urbanism, landscape, forestry, agriculture and tourism) identified nuisances of correlation, creating notational maps, interpretative sections and painting collages. The extensive results conducted by 2 professors and 57 students were exhibited in Lam Dong Province Administrative Center. The project aspires to bring back the integration between “forests and cities” and optimise positive actions of communities towards greater ownership in conservation of urban ecosystems. In months leading to August, additional reflections from the exhibition will culminate in discussions integrating the SDGs, NUA, in a final study. The project acts as a pilot of its kind in Vietnam and as a key example towards global processes worldwide.

**Keywords:** Agro-Forestry Settlement, Urban Forest, Deforestation, Da Lat City, Viet Nam

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## Approach of Online Access to Inventory Data of Urban Trees with ArcGIS (Case of Isparta City)

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The tendency of urbanization increases the importance of natural resources in and around the city. In this context, the urban trees are living organisms and vital elements of green areas and urban spaces. Trees are considered windows of the city that opens to the nature. Urban trees provide ecological services, social/cultural/economic benefits and aesthetic/architectural values. There is a need for a digital database of urban trees in order to recognize research, plan, manage, interpret and make decisions about the functions of urban trees to the urban ecosystem. Accessible databases of trees are needed by government agencies, researchers, landowners and urban people, especially municipalities. Trees must be considered at every stage of planning, design and development of urban. If designed properly trees can provide a significant return on investment and become assets that increase with value over time. The inventory and database of urban trees or forests should be made as scientific and technical. The existing urban trees are regarded as the most important natural data of urban information system. It is also required to reveal of the current situation, data storing, analyzing, querying and its using in a systematic way. Use of knowledge and kept up to date are very important with have the information. The information system includes the storing, the analysis of the existing database and query according to user needs. The main objective of information systems present to alternative solutions to decision makers. This study was carried out under the project "GIS Based Urban Trees Information System (UTIS)" within the scope of the project supported by TUBITAK. This study was performed for the first time in Turkey, Isparta city, for example. With this project, it is possible to access the database of city trees with GIS online. Within the scope of the project, database of Isparta Urban roads and park trees was created by observations and measurements and digitized in ArcGIS and was created in <http://kabsis.sdu.edu.tr>. In order to share and inform to the relevant stakeholders, the individual characteristics of the Isparta Urban trees have been opened to access each tree by means of the online by <http://kabsisdata.sdu.edu.tr/>. In this study, the importance of inventory of urban trees and sharing of trees individual characteristics with online will be explained. In addition, their results and contributions will be discussed.

**Keywords:** Urban tree, Urban Trees Information System, ArcGIS, Isparta city

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# California's Urban Forests: Climate Change, Public Health, and Environmental Justice

*Haydi Boething Danielson<sup>1\*</sup>, Miranda Hutten<sup>2</sup>*

*Cindy Blain, Executive Director, California ReLeaf*

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*2. Miranda Hutten, Program Manager / Urban & Community Forestry - Region 5, US Department of Agriculture Forest Service*

In the course of implementing California's ambitious Climate Change Cap and Trade program, state leaders have dramatically changed the landscape on urban forest public policy and funding. Building on research demonstrating the carbon sequestration, stormwater abatement, air quality improvement, public health and other co-benefits of urban trees, California is mindful of the global implications of regional action. With nearly \$60M available exclusively for urban forestry grants since 2014, California is not only investing exponentially higher amounts in trees, but also tying the grants to the social impacts this funding can bring - particularly in low-income, underserved communities where tree canopy is needed most. Emphasizing social impacts can be replicated in many countries. The groundwork for this funding began 20 years ago with US Forest Service research to quantify the biophysical benefits of trees. The groundwork was strengthened with recent research on the human health benefits of urban trees. Now the urban forest is perceived as a valuable mitigation and adaptation mechanism for addressing the threat of increased urban heat island effect and stormwater runoff due to climate change – as well as providing many other important co-benefits. As the umbrella organization for a network of almost 100 nonprofits, California ReLeaf is the largest statewide urban forest coalition in the United States. With the proactive assistance of the US Forest Service and the ReLeaf Board of Directors, ReLeaf has a unique role in expanding the support of urban forests through collaboration with environmental justice and natural resource organizations, as well as housing and transportation partners. This discussion will share insights and lessons learned on how urban forests came to play such a pivotal role in galvanizing environmental justice supporters, natural resource partners, public health professionals, and policymakers. It is a story of cross-sector cooperation with local and global implications.

**Key words:** Climate-Change, Public-Health, Environmental-Justice, Policy

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# The contributions of greenways to people's quality of life – A case study of the Fuzhou Greenway in China

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Due to rapid urbanization, most Chinese municipal governments attempt to conserve and create more greenspace to make cities more sustainable and meet the huge demands for recreation opportunities in daily life. Preserving green and high-quality urban environments is usually a challenging task, especially as urban development cannot be stopped. The concept of greenways has been known as an instrument to deal with this challenge, as it balances the needs for both conversation and growth. Fuzhou, a city with large areas of mountains and water bodies in subtropical China, is aiming to build a diversified greenway network with a “Green Island Chain” structure that integrated the city's special mountain and water layout. Fuzhou Forest Walkway (more commonly known among residents as Fudao) is a first-of-its kind elevated steel pedestrian walkway system weaving through urban forested areas. It covers 19 kilometers of elevated, winding paths, provide people with access to the city's mountain and forest areas. As an important part and symbol of the city's greenway, it signifies an awakened consciousness to improve the lives of city dweller. Fudao was built as a pilot project and has resulted in great success and popularity, encouraging the government to make the decision to build a citywide greenway network for its residents. The objective of this presentation is three-fold: Firstly, to illustrate how Fuzhou greenways contributes to people's quality of life; second, to depict the greenway's multifunctional nature; and third, to provide a model for greenway planning and implementation for other rapidly urbanizing areas with mountains, rivers and cultural-historical areas. It is hoped that the result will provide new insights on urban greenways and their contributions to people's quality of life experiences. It is argued that construction of the Fuzhou greenway can provide inspiration for greenway planning and implementation across the globe.

**Keywords:** green way, diversify, network, urban forest, Fuzhou

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## **The architect's wood. Bosco Albergati Park by Cesare Leonardi and the local ecological network**

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The aim of the paper is to "read" the development of the wood around Villa Albergati in relationship with the local ecological network. Trees have always been the focus of the architectures by Cesare Leonardi (Modena, 1935), since he travelled around the world taking photos and drawing all kind of trees for his famous book "L'architettura degli alberi" (1982) till he planned and designed some urban parks in Vignola, Modena, Mirandola. He developed the theory of the acentric reticular space structures (SRA Struttura Reticolare Acentrata), a method that bases land organization and management on a subdivision into areas of affiliation with the primary aim of differentiating between tree space and human space. This structure, based on the strategical use of trees and made of irregular polygons, is intrinsically flexible, allowing its application to different urban and territorial contexts. Bosco Albergati Park in Castelfranco Emilia is the only field test of SRA the architect was able to complete (1988-1999), expanding a mature forest with a new 40-hectare park, planted with a wide range of arboreal and fruiting trees. Now the wood is about twenty years old, reading this experience according the ecological role the wood plays in the land it's quite interesting. Is the original pattern still clear? How can the wood be wider to improve its ecological power? A comparison with the ecological regional planning map, shows the relationship of Bosco Albergati with the existing agro-ecosystems, but shows the opportunity to become a strategical stepping stone as well.

**Keywords:** Ecological network, Landscape design, Cesare Leonardi, Rural-urban fringe

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## PS 4.4: Changing Environment – *Chaired by Carlo Calfapietra*

### **Contribution of urban forestry to climate change adaption plan and policies: the case of Mantua, Italy**

*Francesco Musco, Giulia Lucertini, Denis Maragno, Vittore Negretto, Stefano Quaglia*

### **The Role of Urban Green Spaces in the Urban Climate – The Case Study of the City of Bragança (Portugal)**

*Gonçalves A., Castro Ribeiro A., Ornelas G., Feliciano M.*

### **Are Wildfires Knocking on the Built-Up Areas Door?**

*Mario Elia, Leone D. Mancini, Anna Barbati, Luca Salvati, Piermaria Corona, Raffaele Laforzezza, Giovanni Sanesi*

### **Methodological proposals for risk evaluation of urban forest in metropolitan area of bs as, Argentina**

*Craig E., Cucciuffo E., Di Franco L., Bormioli N., Esquivel J.*

### **Urban forest management in India: Challenges under a changing climate and environment**

*Shadananan Nair Krishnapillai*

### **Diseases and Pests Harming Ecosystem Services in Urban Green Spaces of the Mediterranean Region**

*Tiziana Panzavolta, Matteo Bracalini, Riziero Tiberi, Alessandra Benigno, Salvatore Moricca*

### **Understanding post-hurricane tree damages at the Arboretum Doña Inés Park, an urban forest in San Juan, Puerto Rico**

*Christian W. Torres-Santana, Douglas C. Morton, Sebastián Martinuzzi, Bruce D. Cook, Ian L. Paynter, Shawn P. Serbin, Aurelio Castro*

## Contribution of urban forestry to climate change adaption plan and policies: the case of Mantua, Italy

*Francesco Musco\*, Giulia Lucertini, Denis Maragno, Vittore Negretto, Stefano Quaglia  
Iuav University of Venice Planning & Climate Change Lab*

In line with IPPC's findings and international agreements (e.g. COP21 – Paris Agreement, New Urban Agenda) there is evidence that cities, as major centre of production and consume, need to introduce innovative approaches into urban planning system for tackling climate change's impacts and improve the sustainability and resilience of urban and peri-urban contexts. In this context the City of Mantua has started a process for developing its Urban Adaptation Plan, in order to cope with those effects of climate change representing the major concern for its territory, namely: urban heat islands (UHI), heavy storm rainfall, windstorms and flooding. The identification of these impacts, arose thanks to a participatory process engaging local stakeholders in a vulnerability analysis set up by University IUAV of Venice, will allow to make effective this plan in the upcoming future through the definition of solutions for counteract climate change able to integrate different policy sectors, such as environment, public space, tourism, housing and agriculture. With regard to solutions, being identified as key practice to support the long-term adaptation – particularly in terms of cost-benefits and public acceptance, the integration of urban forestry (UF) in the territory of Mantua could significantly contributing to regulate urban ecosystem processes by providing shade, increasing evapotranspiration, mitigating UHI, reducing the energy demand of buildings for heating and cooling and deflecting strong wind. In this view, the aim of this contribution is to present the preliminary results of analysis of Mantua's urban context, the stakeholders perceptions and the different policies, projects and actions already undertaken by the administration for increasing the adaptation capacity of local communities to climate change through the implementation of nature based solutions (NBS) in general, and UF practices in particular.

**Keywords:** urban adaptation, urban resilience, vulnerability reduction

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# **The Role of Urban Green Spaces in the Urban Climate – The Case Study of the City of Bragança (Portugal)**

*Gonçalves A.\*; Castro Ribeiro A.; Ornelas G., Feliciano M.  
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Urban Green Spaces (UGS) are known to change microclimate conditions, improving thermal comfort and reducing urban heat island effect (UHI). The research of the city-climate interactions can be an important contribution for urban planning, providing inputs for the definition of a climate relevant green infrastructure. Starting in 2011, a study is being carried out aiming at the analysis of the urban climate of Bragança (Portugal), a city located in a mountain area with a complex terrain. This presentation focuses on presenting local evidences of the UGS influence on urban climate and the potential role of the local green infrastructure in urban climate improvement. The research consists on a cross-evaluation between meteorological data, gathered from a network of sensors (23 temperature and RH sensors, three wind speed and direction sensors and one automatic weather station) and a GIS analysis of urban and topographical elements. This network covers seven local climate zones, including UGS (4 sensors). Results show that despite the small size of this city (aprox. 30.000 hab) there is an UHI that can be close to 3 ° C in summer with extremes of up to 6° C. Such results are related with the characteristics of the monitored sites showing that UHI is more intense in densely urbanized areas. Other local effects include: an early morning urban cold island effect, the presence of an altitude gradient and of dynamic processes, such as the nocturnal drainage of cold air. Regarding the different UGS in the network, their effects are variable, as reduced UHI intensity is more effective during the summer, mostly motivated by the presence of deciduous trees. UGS are still under the influence of the UHI gradient, thus being mostly warmer than peri-urban locations. Finally, the role of the local urban green infrastructure in Urban Climate Planning is discussed.

**Keywords:** Green Spaces, Urban Climate, Urban Heat Island, Monitoring

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## Are Wildfires Knocking on the Built-Up Areas Door?

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Human-started fires represent the vast majority of wildfires in Mediterranean countries. The current expansion of human settlements into fire-prone territories has led to the creation of landscapes where anthropogenic developments merge with wildland areas. In this context, understanding the role of distance from built-up areas in shaping coarse-scale wildfire spatial patterns is a major concern. Proximity to cities has become an important factor that may increase the probability of wildfires in wildland-urban interfaces. To this issue, we developed an assessment of wildfire distribution in Italy over an 8-year period (2007–2014) to quantify fire occurrence and recurrence as a function of distance from built-up areas. Our findings suggest a positive relationship between the distance from built-up areas and fire incidence (i.e., ratio between burnt forest area and total forest area), whereas a negative relation was found between distance from built-up areas and fire frequency and recurrence; thus, there are more recurring yet smaller sized-fires near built-up areas. Fifty percent of fire events and more than two-thirds of recurrent fires occur within 200 m from built-up areas. On the other hand, the considerable amount of such fire events never reaches an incidence higher than 10% in flat areas and 30% in hilly and mountainous areas. More broadly, quantitative knowledge about where fires occur is essential to ensure appropriate fire management throughout large territories. With this in mind, our investigation intends to provide a solid base for further studies in landscapes with a high component of human-dominated land use.

**Keywords:** forest fire; fire recurrence; fire incidence; Mediterranean region; contour plot; Wildland Urban Interface

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## **Methodological proposals for risk evaluation of urban forest in metropolitan area of bs as, Argentina**

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The Metropolitan region of Buenos Aires generates 48% of the country's gross domestic product and is inhabited by 15 million people. The municipalities in the area have few tools to manage the urban green infrastructure. Many of the species used are not adequate and a large number of specimens are in poor condition, representing a risk to the population. The National University of Luján has worked with more than 10 municipalities in the region to generate simple and feasible risk assessment methodologies and tools to be used in the management of the resource. Based on methods developed in Europe and the US, geo-referenced census were carried out, collecting data on each tree and site, applying a risk index composed of four variables: species, size, type and intensity of defects, and location or target. In some cases the index was adjusted using the sound impulse hammer (Microsecond Timer Fakopp). The data was integrated on GIS program (free and open use) to generate risk maps, useful for planning interventions. It has been found that most of the municipalities use few plastic and low-cost species that generate conditions for the development of diseases. In one case of the studied area, Olivera, we have found that more than 50% are *Fraxinus pennsylvanica* and *Melia azadarach*, two species widely used in the region. The most frequent damages were the decay and cavities produced by wood fungi (35.9%). However, while in *Melia azedarach* 76% of the trees show rotting (50% of them severe), in *Fraxinus pennsylvanica* only 25% presented them. Comparing the presence of severe and moderate decay with the assigned risk index, we found an acceptable correlation. So the presence of this type of defect can also be a quick indicator of the risk of breakage or falling of trees.

**Key words:** risk evaluation, urban forest, tree decay

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## Urban forest management in India: Challenges under a changing climate and environment

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Urban forests have a key role in mitigating the impact of climate change and in maintaining physical and psychological health of the large population in the growing cities of India. Indiscriminate destruction of forests for infrastructure and industrial development worsens the heat waves and hydrological extremes. India is on the path of rapid urbanization. Population growth and migration from the rural area will destroy the remaining forests, especially near slums. Several programmes to increase the green cover are going on in certain cities. The state of Gujarat has initiated a project of associating tree planting with religious practices. However, the concept of green city is yet to become popular. Because of the population pressure, it is difficult to follow international norms in urban forest in India. Most of the cities are far behind in per capita urban forest availability compared to developed nations. Implementation of development programs often fail because of various socio-economic reasons. Urban forests also face challenges from the extremes in climate. Changing government policies have large impact on forests. Recent decision to remove subsidies in kerosene and cooking gas will compel the urban poor to depend more on the forests. Cities require a comprehensive forest management programme such as making multifunctional parks a component of slum modification, utilising parks for storm water catchments and wastewater sewage treatment, recreation and gardening. Urban-dwellers should be made awareness of the full value of forests. In the coastal cities, special attention is to be given for the mangrove forests, as they are vital in protecting the coast from surges and in maintaining biodiversity. An assessment of the current status of the urban forest, of the ongoing and proposed programmes and of the multiple challenges in urban forest management under a changing climate and environment is made in this study.

**Keywords:** urban forest, climate change, environment, socio-economic, policy

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## Diseases and Pests Harming Ecosystem Services in Urban Green Spaces of the Mediterranean Region

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In recent decades there has been an upsurge of disease and insect attacks in trees of the Mediterranean region. At the same time, new pathogens and pests are being reported from urban and peri-urban forests at a rate never observed before. These biotic disease agents pose a serious threat to urban green spaces and to the ecosystem services they provide. The disease phenomenon is related to an increase in drought events, which are more pronounced in the Mediterranean area than elsewhere, being this an hotspot area for climate change. A number of thermophilic or thermotolerant fungi, such as some members of the Botryosphaeriaceae and Xylariaceae, as well as insect pests such as *Rhynchophorus ferrugineus* and *Matsucoccus feytaudi*, are causing extensive disease and mortality to trees in urban green areas. Such an increase in disease and insect outbreaks is in part also due to the exceptionally mild winters of recent years, which are enabling an ever-increasing number of infectious propagules and insects to survive through the winter. Clearly, these biotic disease agents are also undermining essential ecosystem services provided by urban greenery, such as carbon sequestration, urban microclimate mitigation, dust and noise abatement, or opportunities for tourism and recreation. Current climate trends suggest that in choosing tree species for planting in urban and peri-urban areas, more attention should be paid in future not only to the tolerance of these trees to abiotic stresses, but also to their resistance to pathogens and pests.

**Keywords:** fungi, insects, outbreaks, climate change, biotic stress resistance

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## Understanding post-hurricane tree damages at the Arboretum Doña Inés Park, an urban forest in San Juan, Puerto Rico

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During September 2017, two catastrophic hurricanes (Irma and María) with winds up to 250 km/hr. devastated the island of Puerto Rico. Besides the billions of USD in damages caused to its infrastructure and economy, the urban forests and its green infrastructure also suffered. The Arboretum Doña Inés Park of the Luis Muñoz Marín Foundation is an urban forest that was planted since 2000 for conservation, education, and research purposes. Prior to the hurricanes, it contained nearly 1,300 accessions of mostly trees from 250 native species from Puerto Rico and the Caribbean, including endemics and some of the rarest species on the island. With the help of volunteers, CWTS surveyed and evaluated the living collections post-hurricane by measuring tree DBH, height, and crown and root damage in order to understand tree damage. An unmanned aerial vehicle or drone was flown on days 7 and 139 after hurricane María to understand its impacts from an airborne dimension. A total of 463 of 1,276 (36%) monitored plants were devastated, uprooted, had broken trunks/branches, and/or could not be saved. As a consequence, trees representing hazards to visitors and infrastructure were cut, pruned, and others stand up. Prior to the hurricanes, on March 2017, the arboretum was flown by the NASA G-LiHT (Goddard's Lidar, Hyperspectral and Thermal) airborne imager combined with a terrestrial Lidar used in the ground. While cleanup work is still ongoing for seven months after the hurricanes, NASA flew the same paths post-hurricane during April 2018. Our presentation will show very detailed airborne remote sensing data acquired with the NASA G-LiHT over the arboretum before and after hurricanes Irma and María. It would also discuss the recovery process currently taking place using arboriculture techniques for restoring, evaluating and mitigating future hazards to this important and diverse urban forest in San Juan.

**Keywords:** G-LiHT, Lidar, hurricane, biodiversity, Caribbean

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## **Parallel Session 5 – The Future**

## PS 5.1: Changing People – *Chaired by Sheila Wertz*

### **Future funding of urban forests – time to move to a beneficiary pays model?**

*Helen Davies, Marije Schaafsma*

### **The psycho-social effects of tree-removal from urban parks**

*Camilo Ordóñez-Barona; Caragh Threlfall; Jess Baumann; Chereese Sonkkila; Dave Callow; Rodney van der Ree; Melanie Davern; Richard Fuller; Stephen Livesley; Dave Kendal*

### **Making the Urban Forest 'speak' to citizens**

*Urmila Rajadhyaksha*

### **The Charter for Trees Woods and People - A framework for the future?**

*Niall Williams*

### **Lessons from "Las Praderas" - Community relations and implementation of green technologies in urban forests**

*Nicole Heise, Camila Sattler*

### **Green Care FOREST**

*Franziska Krainer*

### **Bogota's Urban Trees Master Plan**

*Germán Tovar Corzo*

### **Stakeholder empowerment yes, but how? - From bargaining to cooperation**

*Bianca Baerlocher*

## Future funding of urban forests – time to move to a beneficiary pays model?

*Helen Davies\*, Marije Schaafsma  
University of Southampton*

Despite the wide range of ecosystem services (ES) that urban forests provide to society, local government budgets for tree planting and maintenance have declined in many cities throughout the world. Consequently, councils are increasingly turning towards citizens and businesses for support, though this is typically through ad hoc and small-scale sponsorship. Our recent work has shown that, subject to certain conditions, businesses are willing to help fund urban forests and the ES they provide via ‘payments for ecosystem services’ (PES) schemes. Via survey-based choice experiments carried out with approximately 300 citizens residing in Southampton, UK, our latest study aimed to find out whether citizens are also willing to contribute to urban forest PES schemes. In contrast to the perceptions of UK-based tree officers, citizens rate the benefits of urban trees (including regulating ES) as significantly more important than the nuisances they cause. The majority of respondents are willing to contribute towards street tree planting in the city (particularly larger trees), with willingness-to-pay (WTP) highest for aesthetic enhancement, followed by air purification, and then surface water attenuation. Those who are concerned about Southampton’s growing pollution and flood problems are willing to pay more for this nature-based solution than those without such concerns. Finally, whilst WTP is lower overall when uncertainty in the delivery of ES from urban forests is revealed, many respondents perceive this information to be more credible than that which suggests all trees provide all ES with certainty, and/or are willing to give the scheme the benefit of the doubt. This study has implications for local authorities wishing to trial new sources of urban forest funding, and will be particularly useful for helping to avoid situations such as the widespread public backlash to the felling of healthy, mature street trees in Sheffield, UK.

**Keywords:** payments for ecosystem services; citizen preferences; willingness-to-pay; street trees; urban forest governance

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# The psycho-social effects of tree-removal from urban parks

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Urban trees are critical for the future of sustainable cities. While many cities have ambitious targets to increase tree-canopy cover, many municipal governments also spend millions of dollars planting and maintaining urban trees every year. The services that trees provide are more significant as trees age and increase in size. However, large, old trees pose a hazard to human safety and hinder construction activities, and hence are often removed. This means that streets and parks where trees are planted often experience rapid loss, absence, and slow recovery in tree canopy cover. While the negative effects of this on environmental service provision, such as shade, are straight forward, today there is no clear understanding of the psychological and social effects of tree removal, such as preference, perceived benefits, and subjective well-being, among others. This is because most research on tree-removal focuses on the big spatial patterns of tree-stem and canopy loss and their influence of these patterns on health parameters, such as respiratory illnesses. To fill this gap, we report on a before-after-control-impact experimental investigation on the impact of tree loss on psycho-social parameters at selected treescapes in the City of Melbourne. The study focused on the changes in psycho-social processes (i.e., attitudes, perceived benefits, well-being, nature connectedness, and walking activity) after trees were removed from selected sites. We present some of our initial results and take the opportunity to reflect on the socio-ecological effects of tree-removal at small spatial scales across the city.

**Keywords:** urban sustainability; socio-ecological systems; environmental psychology; urban forest management

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## Making the Urban Forest 'speak' to citizens

*Urmila Rajadhyaksha\**

*Head of the Department, M.Arch Landscape*

When the Forest Speaks.....

What is rarely appreciated or even understood by many a city dweller is the role played by forests in sustaining his life. Very often the forest is regarded as dangerous by urban citizens and civilising the land by making it seemingly productive as in agriculture and of use to the civilised denizen of our urban world. Some forests have survived by being designated as spaces for recreation over the years but as recreation spaces, do they remain the forests they were? Natural forests in urban spaces have changed from game reserves to parks. Urban growth has swallowed up forests, chased away dwellers who lived in peace with them and probably sustained them. Urban development often snakes through the forest fabric fragmenting them and leading to loss of connectivity. But where does this loss of connectivity really begin? Is it when the denizens do not hear each other speak? Have today's urban citizens lost the ability their ancestors had to hear the Forest speak? Could that be a point to begin? Would that restore connections? And with restored connections values? That which is valued is not easily destroyed.

**Keywords:** Forest speak, connectivity, values, Forest Fabric

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## The Charter for Trees Woods and People - A framework for the future?

*Niall Williams*  
*The Landscape Institute*

The Charter for Trees Woods and People (Tree Charter) is the personification of the aims of the World Forum on Urban Forests and is created from the UN sustainability goals. The charter developed using a ground-up approach engaging the public through events, encouraging people to write stories about why trees are important which are integrated into its core. A steering group was developed to provide the technical knowledge, research and understanding to inform the charter making it practically applicable. This encompassed professionals from Urban Design, Planning/Architecture to Farming, Forestry, Public Health, Heritage and Faith-based organisations. The aim of this project was to collectively create a Tree Charter for the modern day. It's a new approach ensuring the role trees and woods play in our lives can be visible and will be realized in decision-making and practice in homes and neighbourhoods across the UK. The charter was inspired by the Charter of the Forest 1217 and unveiled to coincide with its 800 year anniversary. Upon unveiling in November 2017 the charter had been informed by over 60,000 stories shared by a diversity of people. Its development drew an audience of over 70million people over 2 years. Over 700 experts, academics, campaigners and enthusiasts shaped its 10 guiding principles which were agreed by more than 70 organisations. Over 130,000 signatories have signed the charter in support of those principles to date. The framework could be applicable anywhere due to the level playing field it creates for multi-disciplinary and cross-sector working. It's capable of breaking into specific working groups that feedback towards a collective vision to tackle a complex range of issues. The legacy of this project is to support other nations to develop their own charters whilst strengthening the role of the professional panel at home. Leading towards embedding the Tree Charters principles into society.

**Keywords:** Cross-Sector, Internationally applicable, collaboration, societal

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## **Lessons from "Las Praderas" - Community relations and implementation of green technologies in urban forests**

*Nicole Heise\*, Camila Sattler  
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FICUS is an NGO currently managed mainly by young peruvian women. Our goal is to improve the quality of life of people through the use of green technologies. Between 2015 and 2017 we carried out a pilot project in the slum "Las Praderas", located in Lima. As most slums in Peru, the expansion of urbanization on the hills of the city started as an invasion, making them prone to landslides catastrophes, also they pose a risk to the Lomas ecosystem. Lima as a whole, it is a city with less than 2 square meters of green areas per person, therefore our project focused on the link between environmental conservation and social development. We aim for the implementation of green technologies to achieve social and environmental sustainability in our city. One of our biggest assets was to convert previously informal landfill into green recreational areas. Throughout the project, FICUS conducted a series of social instruments such as workshops with the local population, or "participatory rural diagnose" which is a tool that enables the community to make its own diagnosis about the current situation and their expectations for the future. We implemented this tool with interesting results and guides for methodological adaptation for urban areas. This experience also revealed that, although having local stakeholders involved in the project is important, working in activities with the whole population is crucial during all phases of work. The project has also showed interesting results about the intersectionality of needs and how environmental, social and economic requirements may have a different hierarchy when analyzed together. Also, the importance of working in a network with governmental authorities dividing tasks and securing channels for the transfer of capabilities and knowledge to assure the replicability and sustainability of the project without the dependence on foreign aid. For an introductory video, please visit: <https://www.youtube.com/watch?v=WCGfMfVnnZg>

**Keywords:** Youth, slums, conservation, reforestation, project management

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# Green Care FOREST

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Forests have a multitude of positive effects on our lives: They filter our water, they protect us from natural hazards and they are of considerable economic importance - to name just a few. Urban forests play a key role in contributing to the health and well-being of citizens. Forests reduce ultraviolet radiation and noise, they cool the heated city air and atmosphere, they filter pollutants and allergens. In addition, forests provide the perfect setting for leisure and recreational activities and support citizens in recovering from their often stressful daily lives. Nowadays, more than 50% of the world's population lives in urban areas. As a consequence of this urbanization, green space is becoming scarce. The possibilities for citizens to be in nature are getting fewer and people no longer get to experience the soothing effects nature can provide. At the same time, so called diseases of civilization are on the rise. They often result from a stressful work life, a mainly sedentary lifestyle and a lack of physical activity. Forests, especially urban forests can play an important role in counteracting these symptoms. Many studies emphasize the positive effects of forests on physical and mental health and the overall potential of forests of fostering human health and well-being. The Austrian Research Centre for Forests has a strong focus on realizing and unleashing the forests' potential for improving health and social aspects of nowadays society. In particular, the project Green Care FOREST deals with social engagement, health and well-being in the forest. We act as an interface and mediator between forest owners and social institutions. We initiate and realize best-practice projects, where the forest setting becomes a place for disease prevention, education, work and social integration. We present insights in our work and discuss the potential of urban forests for health and well-being.

**Keywords:** Health, well-being, social services, Green Care, Forest

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## Bogota's Urban Trees Master Plan

*Germán Tovar Corzo\**

*Secretaría de Ambiente de Bogotá*

Currently, urban tree management is materialized in isolated, fragmented, isolated designs, without a functionality that is integrated with the natural conditions of its ecological structure. In this way, we only work by intuition without having megaprojects that have a decisive impact on urbanism and therefore the lives of its inhabitants. The challenge of the metropolis is to structure an institutional framework that allows the management of urban trees in an integral way. Most cities doesn't have an institutional leader, who has participation in the instances in which planning decisions are made, that regulates, controls and coordinates the management of the different public dependencies on the trees, and that also influences in the participation of private companies and society in general. This institutional architecture is presented in Bogotá, Colombia, where its environmental authority coordinates the management of 31 public entities. After the analysis of its georeferenced arboreal census, the Master Plan for Urban Silviculture of Bogotá was formulated, for a period of 12 years, main theme of this presentation-, which seeks to improve the institutional capacity for the evaluation and technical management of green coverage, increase social appropriation of citizens through information and knowledge. Likewise, it aims to increase the connectivity of the ecological structure, increase biomass production and shadow, as well as improving indicators of population per tree, one tree per 6 inhabitants, and 4.2 m<sup>2</sup> of green area per inhabitant, although distant from that recommended by WHO, 3 and 9, respectively. Besides, it is expected to promote the use of the urban tree management system as a tool for monitoring, evaluation, planning and management of urban trees; and the identification of topics research that the city requires. To achieve this, the plan aims to develop seven programs with 81 projects with an estimated budget of US\$ 530'000.000.

**Keywords:** Green infrastructure, Urban forestry, Green cover management, Urban green áreas, Sustainable cities.

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## Stakeholder empowerment yes, but how? - From bargaining to cooperation

*Bianca Baerlocher*  
*Urban green polylogue*

The kind how citizens get involved in decision making will continuously change in the future. Namely, the idea of sustainable development is questioning the power of authorities and demanding self-determination and responsibility and new forms of legitimisation. But the shift from top down to bottom up decisions is challenging most of the planning processes and still a huge barrier in the urban forestry sector. The questions about this trend is:

- a) What are the specific urban forest-related goals enhancing participation within the urban surrounding
- b) Different stakeholders means different positions: What does empowering mean for what group of stakeholders? And: How can the different stakeholder groups ranging from political decision-makers to urban forest visitors be empowered?
- c) How can inequalities of power be balanced within a process? How can “non-organised” stakeholders be empowered?

The presentation will focus on different types of involvement ranging from pure information to consultation, to dialogues or to mediation process of conflict parties by giving examples from our case studies in the forestry sector. This differentiation will illustrate the various perception of power constellation made by stakeholders from a sociological point of view. We will explain how to come from well-known bargaining strategies to cooperation within a process by using mediative tools. Therefore the presentation will highlight helpful concepts of how to get people involved and how to recognize the needs behind different positions of stakeholders. The hypothesis is, that the recognition of interests and needs will lead to transformation and social learning. Therefore the “how” we communicate, is the challenging part. The aim of the presentation is to inspire the knowledge transfer from experiences in mediation processes with experiences concerning participation in urban forestry.

**Keywords:** empowerments, interests and needs, cooperation, mediation

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## PS 5.2: Changing Spaces and Places – *Chaired by Nerys Jones*

### **MN50. Re-identifying the Industrial Heritage Sites: The Engine for the Historical City's Future Landscape**

*Sanya Kovacheva, Veronica Rigonat*

### **The new Northern Forest in the UK : a project designed to heal the wounds of post-industrial neglect by applying the concepts of the New Urban Agenda to a multi-regional urban/peri-urban forestry initiative**

*Alan Simson*

### **Bioclimatic Cities of the Future. Conceptual Strategies for Modular Green Space Systems**

*Vladimir Ionut Boc*

### **New urban forests in layering landscapes**

*Lucina Caravaggi, Cristina Imbroglini, Anna Lei, Manuel Lentini*

### **Seismic Green Infrastructure: EKSOTECTURES & EKSOSCAPES**

*Ferdinand Ludwig, Stefano Panunzi*

### **Conciliating human density and green spaces in cities: What urban design could be better for a sustainable future?**

*Demóstenes F. Silva Filho, Eduardo R. Alexandrino, Patricia M. Sanches, Marcos A. Melo, Ricardo B. Machado, Augusto J. Piratelli*

### **Some aspects on maintenance/land use around the trees in urban areas,an overview of Pogradec city, Albania**

*Hajri Haska, Eneida Haska*

### **Forest urbanism in the Campine region, Belgium**

*Wim Wambecq*

## **MN50. Re-identifying the Industrial Heritage Sites: The Engine for the Historical City's Future Landscape**

*Sanya Kovacheva\* Veronica Rigonat*

MN50 starts as a master thesis aiming to suggest a future scenario for the city of Mantua, a UNESCO protected city, which nowadays has to face many complexities inherited from the last decades. The project then evolves into a theoretical study on medium-size European cities characterized by a strong historical identity and a relevant industrial past. Mantua is a special case not only for its outstanding universal value of culture, but also for its natural asset: the territory belongs to multiple protected natural areas, with no exception of Inferior Lake's left bank. An area, which hosts the partially inactive and heavily contaminated productive core of today. Additional paradoxes of the territory overlap with the presence of deprived neighborhoods meeting the industrial borders in critical margins. What the study-project suggests is the usage of the urban forest in Mantua as powerful multipurpose tool in facing the challenge of communication between former productive areas and the historical city. It revives the currently disconnected ecological corridors and solves the contamination issue through biological remediation, so could the city's neighborhoods be reactivated. The urban forest is permeating the industrial patrimony: either the production lots are converted into environmentally sustainable manufacturing areas, focusing on the quality of the working space, either they are invaded by nature and transformed into new spaces for the community. Making the heritage now active and living. Cities' governance still faces today the difficulty to manage simultaneously all aspects of urbanized territories in a synergetic way. In MN50, Mantua is seen as pilot site, suggesting the urban forest as a guiding element for generating better inhabiting environment for the future citizens.

**Keywords:** identity, industry, landscape, margins, UNESCO

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# **The new Northern Forest in the UK : a project designed to heal the wounds of post-industrial neglect by applying the concepts of the New Urban Agenda to a multi-regional urban/peri-urban forestry initiative**

*Alan Simson\**

*Leeds Beckett University, Community Forest Trust, UK.*

Since the 1980's, a number of Community Forests have existed in the north of England. They have successfully delivered new areas of urban / peri-urban forestry in and around many of the major towns and cities, restored areas of degraded, post-industrial urban fringe landscapes for the benefit of local communities and assisted in attracting significant economic investment into their areas. Building upon these successes, the Community Forests have recently combined forces with the Woodland Trust, the leading pro-tree charity in the UK, to promote a vision of a new Northern Forest. The Northern Forest will extend from Liverpool in the west across to Kingston-upon-Hull in the east, and will plant over 50 million trees over a period of 25 years. Although the plan is still evolving, it has been endorsed by the UK Government by donating £5.7 million towards the project. Not only will the Northern Forest provide biomass and future timber, but it will also deliver wide social and environmental benefits to improve the health of local urban communities, reduce flood risk, tackle poor air quality, improve water quality, provide opportunities for recreation, tourism and leisure, and create attractive places in which to live, love, work and invest. The concept also meshes very much with the UN's New Urban Agenda (NUA) by promoting a shared vision of sustainable and inclusive urban prosperity, opportunities for all and environmentally sustainable and resilient urban development. This presentation will discuss the research that provided the convincing economic and social justification for the concept, and the benefits that will accrue to both the current and future populations. In addition, the work of the White Rose Forest will specifically be considered, a Community Forest that covers over 5000 km<sup>2</sup> of the central zone of the Northern Forest, and which is helping to deliver the UN's NUA in this part of the UK.

**Keywords:** Northern Forest, urban/peri-urban forestry, New urban Agenda, White Rose Forest

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# Bioclimatic Cities of the Future. Conceptual Strategies for Modular Green Space Systems

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The approach is focused on introducing the bioclimatic security concept in landscape planning. Given the ability of the vegetation to modify microclimates, a landscape zoning for peri-urban areas is proposed. The concept is based on using different types of green areas with distinct microclimatic roles in order to develop modular green space networks at different city scales to ensure comfort and security for human communities. The temperate-continental climate in Bucharest, which is taken as case study, is characterized by moderate rainfalls, dry summers and major thermal differences between winter and summer. The bioclimatic discomfort is exacerbated by air and phonic pollution, dust and a low air ionization level. The proposed modular green space system acts as driver for sustainable urban development by harmonizing the relationship between the built areas and the natural environment. Thus, the urban fabric is generated in accordance with the bioclimatic landscape zoning and with the local climate conditions. The buildings are integrated into green urban modules bordered by shelterbelts and buffer green areas, around a green-blue core, crossed by two ventilation corridors, opposing the dominant wind directions. Each type of green spaces aims to attenuate different urban climate threats such as strong winds, snow storms, fog, dust, air pollution, air stagnation, thermal discomfort, etc. The interdependency of green infrastructure and urban fabric aims to optimize the microclimatic impact of a multifunctional green space system, increasing the resilience of human habitats. The bioclimatic city concept would provide a multitude of socially viable spaces such as public parks, a functional network of bicycle and pedestrian trails, orchards and vegetable gardens. Human security dimensions such as environmental security, health security, food security, community security are improved through the benefits of urban forests and farming areas which are interconnected and integrated into the urban form at functional and ecological level.

**Keywords:** Bioclimatic landscape planning, Green infrastructure and urban forests, Modular green space system, Human security

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## New urban forests in layering landscapes

*Lucina Caravaggi\*, Cristina Imbroglini, Anna Lei, Manuel Lentini  
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It is rather frequent that the proposal to create new urban forests arouse distrust and scepticism on those who are concerned with the protection of the landscape. The imaginary of forestation as a "covering" practice, that erases variety and evolutionary traces under the green implantation is still very active and seems to cross the deep-rooted imagination of the "selva", connected to collective perceptions of fear and insecurity. However, when faced with the changes that are profoundly transforming metropolitan regions around the world, the process of homologation related to the forests does not seem so worrying. The resistance is perhaps precisely in the face of radical transformations in progress. Secondly, there are still, in our country, achievements able of spreading new imagery of the urban forest, such as to bring back this element – also historically recurrent – to the local values of biodiversity, to new outdoor collective practices, to the needs of sustainable mobility. In this direction many landscape projects underway in the urbanized territories of Rome have assumed the forest not only as an element of ecological rebalancing but as a motor for reorganization and improvement of urban spaces and activities, a factor of sociality, health, environmental awareness, green economies, etc. These projects explore three main intervention hypotheses, which are declinable in similar territories:

- a) Increase of the linear forests along water lines of the hilly and plain landscape, historically inseparable image from the plot of woods and thickets, precious for a set of consolidated ecological functions, but also for new urban meanings, connected in particular to sustainable mobility.
- b) Revival of destroyed or degraded forests because of agricultural industrialisation, especially within the public agricultural estates and the large abandoned hospital complexes.
- c) New forest implantation in the coastal areas of the large XX century reclamations, characterized by polluting and scarcely productive agricultural activities.

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# Seismic Green Infrastructure: EKSOTECTURES & EKSOSCAPES

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*2. University of Molise*

Italy is a highly seismically active region. Moreover, Italy has plenty of old buildings. When combined, the two aspects can lead to serious and fatal damage. Since demolition and reconstruction is not an adequate solution, many buildings are retrofitted by external supporting structures. These structures are obviously a technical emergency solution that denies any significant design contribution. At a second glance, however, this eksoskeleton construction offers great potential: it can be used to supplement missing spaces, add multiple additional uses and update technical infrastructure (EKSOTECTURES). Moreover, these elements could serve as support structures for vertical plant systems and thereby form new biotopes and thus can become an essential part of urban green infrastructure (EKSOSCAPES). In a first step of the collaborative research project concepts for the Italian City of Campobasso were developed, among other things, an analysis of particularly earthquake-prone buildings was superimposed with the city's green developmental plan. Based on this a “seismic-green-masterplan” was developed. It consists of different strategies that use the technically necessary retrofitting of existing buildings as a chance to create and enhance green urban corridors – nature based solutions for urban health and safety. In a second step we will examine in what way living trees could play a role in eksoskeleton structures to stabilize the buildings and to damp earthquake induced vibrations. This forward-thinking approach is based on finding that forest are able to mitigate the seismic waves, that strangler figs are able to strengthen their host tree and to protect it against hurricanes as well as on first findings on the supporting structures made of living tree roots by the Khasi People in India. In our talk we will present results as well as the scientific and methodical basis for the upcoming research steps.

**Keywords:** Baubotanik, Green Infrastructure, earthquake, exoskeletal retrofitting, living architecture

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## Conciliating human density and green spaces in cities: What urban design could be better for a sustainable future?

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Urban planners and researchers have reported negative relationship between urban density (i.e., demographic, housing and built density) and the establishment of green spaces in cities (e.g., tree canopy cover). While the lack of urban green spaces cause significant impact on residents life quality, on regional biodiversity and low ecosystem services provisioning, the increase of human population in cities claims for discussions towards how conciliate density and green spaces. Therefore, we are assessing human density, tree canopy and bird communities within eight residential typologies (i.e., an urban design component: horizontal, vertical, mixed horizontal and vertical, traditional compact block, edge block, half-open block, modern open block and contemporary open block) present in three cities that have different urban planning context (São Paulo, Federal District and Berlin). Although the human density was highly disparate among mixed and vertical typologies (respectively, 76.8, 104.3 and 147 dwellings/ha, São Paulo data), we observed low tree canopy (1.5-6%), and, consequently, similar bird community among these areas. In Federal District, a residential area planned under modern open block showed less human density (i.e, 56.2 dwellings/ha) than in the horizontal typology (78.9 dwellings/ha), but they showed high percentage of tree canopy (25% against 2.4% in horizontal), which allowed the occurrence of a richest bird community. Open block also harboured a bird community more similar with those of urban parks. The contemporary open block (Berlin data), showed similar density as observed in vertical typology of Brazilian cities, but they have tree canopy three times as much the vertical. Our bird survey in Berlin was ongoing until the close of this abstract, but their bird preliminary results will be showed in the event. We intend to promote a high level discussion in our presentation, under an interdisciplinary background, in order to add knowledge for future planning of green spaces in cities.

**Keywords:** urban planning; urban forestry; urban birds; resilient cities; compact cities

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## Some aspects on maintenance/land use around the trees in urban areas, an overview of Pogradec city, Albania

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Trees and shrubs are the base structure of urban greenery, associated with other important elements such as flowers, grass, alleys, sidewalks, water bodies, wood-work, sculpture, artistic/art works and everything else in the field of greenery. After planting, the way of maintenance/use land around trees in urban areas is a very important aspect. Based in size of seedlings, growth prospects of trees, especially in diameter, place where it planted; in the urban forests, sidewalks, along the streets, in the yard of houses or institutions, river banks or lakes and water bodies, kind trees, management way, are some factors considered for choose the best way of land use around the trees in the urban areas. Considered some aspects like:

- Management way: high forests, coppice, shrubs, combined.
- Organization way: dispered trees, trees in rows, in corridors, trees in groups, forests
- Form: square, rectangular, circular, sloping, corridor, irregular shape.
- Surface: hole during sowing, planting site, current seedlings, growth prospects, available space
- Construction area around trees: directly on the ground, with sidewall, stone, wood, iron.
- Way of maintenance: worked soil, un-worked soil, with grassy, flowers, mulching, other materials.

City of Pogradec, analised in study, one more beautiful cities in Albania, lies in the S-E of the country, on shore of Ohrid Lake, deepest lake in Europe, annual average temperature reaches 12.3°C, and 730 mm rain, 700m asl, 28848 inhabitants. In this very beautifull city, during comunisem period came here comunist leaders(EH) for vacation, city have a lot of greenery area, evident with trees, shrubs and grass, within the city and suburbs, a very good architecture of bildings and streets. Some from above issues are teated in presentation, in order to increase the efficiency of the ways of maintenance the soil around the trees in urban areas, with main aim of finding most appropriate way which gives maximum benefit to both, for nature and community/society.

**Keywords:** maintenance, soil, trees, around trees, greenery, Pogradec

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## Forest urbanism in the Campine region, Belgium

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The law on the exploitation of uncultivated terrains of 1848 in Belgium boosted the landscape inversion in Belgium during the 19th Century: large pieces of forest on fertile soils were harvested to cover the expenses of the power succession in the transition from the Ancien Regime to the Belgian nation-state, counter-balanced by the large-scale coniferous afforestation – both in the scale of the plantation, as on the scale of the region - of the sandy, infertile soils of the Campine region. For more than a hundred years, the Campine's large-scale coniferous forests have shaped, and will continue to shape the character of the Campine region. This continuous operation of forest urbanism gives a different perspective on the importance of forests in the urban environment. Rather than focusing on “classic” urban forestry, the emphasis lies on how the forest influences urban processes. The perspective of looking beyond the forest's domain (in time and space) might contribute significantly to the role of the forest in the future. Through three cases in the Campine region the notion of forest urbanism is explored in past, present and future. The large scale coniferous afforestation created the frame within which a different urbanity grew. E.g. urban appropriation of the forest as a cultural landscape – e.g. as a military domain - resulted in the forest's transformation into newly established and safeguarded ecologies. In other cases forest and urban structure – e.g. leisure domains - find an intimate codependency. This illustrates the main strengths of forest urbanism as a concept: the relation between forest and urban is cyclic and can be mutually enriching; a multiplicity of forest urban figures is created in the process, leading to a specific urbanity; and finally the forest-urban interface is both dependent of as it determines the image of the urban environment.

**Keywords:** Forest Urbanism; Landscape Urbanism; Campine region; Flemish Dispersion

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## PS 5.3: Changing Environment – *Chaired by Maria Chiara Pastore*

### **Creating ecosystem services through urban oases: stormwater management landscaping in Southern Finland**

*Outi Wahlroos, Anna Halonen, Pasi Valkama, Mari Pihlaja-Kuhna, Kari Rantakokko, Harri Vasander*

### **SDI Spatial Data Infrastructure Integrated Ater Roma**

*C. Calfapietra, L. Campoli, G. Mongelli, A. Napoletano, L. Tosi, D. Battista, A. Cinquini*

### **Mapping the permeability of cities to forest migration under climate change**

*Qiyao Han, Greg Keeffe*

### **The potential influence of nursery offerings on tree species diversity in new Beijing plain afforestation**

*Sun ZhenKai, Wang Cheng, Xu Xinhui, Zhao Yilin*

### **Indirect root distribution detection by 2D Electrical Resistivity Tomography. Application to Pinus pinea root system, in different soil type with a field approach**

*Giambastiani Y, Preti F, Errico A, Guastini E, Censini G*

### **A fast and ultra-spatially resolved method to monitor PM concentration in cities from PM deposition on urban trees**

*Chiara Baldacchini, Gregorio Sgrigna, Woody Clarke, Matthew Tallis, Carlo Calfapietra*

### **Urban and peri-urban vegetation can improve air quality in Mediterranean areas**

*Rocío Alonso, David Elustondo, Héctor Calvete, Miriam Serrano, Enrique Baquero, Jose Luis Santiago, Esther Rivas, Susana Elvira, Sheila Izquieta, Héctor García-Gómez, Ignacio González-Fernández, Jesús M. Santamaría Victoria Bermejo*

### **The rise of urban agroforestry systems – a comparative analysis of the United States/Canada and Germany**

*Rico Hübner, Stefanie Künstle, John F. Munsell, Stephan Pauleit*

## Creating ecosystem services through urban oases: stormwater management landscaping in Southern Finland

*Outi Wahlroos\*, Anna Halonen, Pasi Valkama, Mari Pihlaja-Kuhna, Kari Rantakokko, Harri Vasander  
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(UUDELY); University of Helsinki*

In the Life+ ENV/FI/911 Urban Oases-project (2012-2017) we designed, implemented and monitored for success nature-based stormwater management parks. The project team consisted of a multidisciplinary team of academic, municipality, environmental governance and watershed protection association. With the stormwater management landscapes our many aims included to mitigate state of urban environment and the receiving waters as well as to turn stormwater from waste to joy. The project pilot landscapes were built to provide many ecosystem services such as flood control, water pollution control, habitat, placemaking and recreational amenities. The functional landscapes designed included stormwater wetlands, endangered clay stream habitat and vegetated swales. The wetlands and clay stream habitat proved to create oases for fauna and locals alike. Establishing vegetated swales in existing urban areas was a challenge due to lack of space and accurate information especially on below ground structures. While tree planting in swales is ideal, the limited root zone space limits tree planting regardless the use of structural soils. Knowledge on expectable function of nature-based solutions help planning and decision making. We monitored thoroughly a stormwater wetland named Gateway in Nummela, Vihti, Southern Finland. The Gateway wetland comprises just 0,1% of its watershed area. Each year after construction the undisturbed vegetation became lush and water quality mitigation improved. The fifth year the wetland removed 21% of total phosphorus, the limiting nutrient to blue-green algae, on an annual basis as calculated from continuous monitoring data. Herbaceous species number increased from initial 50 to 150. Biomass of the wetland perennials was tenfold more than that of lawn. The wetland was nearly carbon neutral. The wetland attracted much fauna including increasing numbers of spawning amphibians each spring. Finally, interviews showed that locals were willing to pay more for nature-based stormwater management than what the municipality was using for conventional stormwater management.

**Keywords:** nature-based stormwater management, ecosystem services, created wetlands, place making, created habitat

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## SDI Spatial Data Infrastructure Integrated Ater Roma

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Ater Roma accounts for 50,000 accommodations, 3 mlns of external areas, 30,000 trees, 1,500,000 square metres of external space, about 200,000 inhabitants, and thousands of heating systems, DECA manages 700.000 mq of green areas. Ater can be considered as a national reference model. We launched a platform for the management of urban forest, the aim is to find which type of greenery should be planted in order to find which plants are the most efficient in absorbing co2 and fine particles, and the optimization of ecosystem services provided by urban forest included CO, BVOV, organic compounds, and reducing pollutants. The open areas for about one hectare will be landscaped and upgraded as a model of the "ideal green city", constantly monitoring its balance thanks to the industry 4.0 technologies offered by Welcome2©. The integrated system that DECA is going to create will: provide a tool for 360° governance of the territory, be scalable and extendable indefinitely using Welcome2©'s ontologies system that will allow the user to create new objects and link them to contracts and the resulting operational activities. The system for the management of Urban Forestry will be at the centre of the project, to which sensors and control units will be connected on the territory, as well as smartphones of operators and possibly citizens. All data will be available and recorded, put into graphical representations (DWG, GIS), and data recorded will always be accessible in the main panel of said Public Body, and possibly published on a portal for citizens. This data will be the base to guide administrative action towards maximum energy efficiency and towards the realization of a zero-emission Ater system. The Mission of the Project is: reuse and recycling, with a view to an efficient circular economy; sustainability; resilience; increased biodiversity; energy saving; water saving; reduction in the use of plant protection products; reduction of co2 and fine particles; correct use of technology.

**Keywords:** urban forestry, sustainability, data infrastructure, pollution reduction,

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# Mapping the permeability of cities to forest migration under climate change

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In response to global warming, many tree species will need to move to new habitats with more suitable climate conditions. While in previous eras, trees were able to gradually shift their range through an uninterrupted landscape, future tree migrations will have to overcome substantial human-created barriers, such as agricultural land, cities, roads, and other infrastructure, which may impede their ability to track rapid climate change. In this research, we develop a method to map the permeability of cities to forest migration and use the Greater Manchester area, UK as a case study to demonstrate this method. Our method avoids a tree species-specific perspective but focuses on the foraging behaviours of dispersal agents that can disperse seeds for multiple tree species. In this research, birds are selected to represent dispersal agents based on their important roles in the range expansion of trees, especially in terms of long-distance dispersal. Since birds experience their landscape as hierarchical mosaics of patches, the multi-scale structures of urban greenspaces are mainly considered. Our method combines both least-cost path models and graph theory-based analyses. Least-cost path models are applied to map the pathways of birds at habitat and home-range scale, while graph theory-based analyses assess the availability of birds at each scale. Our resulting map of Greater Manchester identifies land areas with the potential to facilitate the climate-driven migration of trees. We found that overall, only 8.8 percent of the land area in Greater Manchester is permeable or semipermeable to forest migration. In Rochdale and Oldham district, particularly, just 0.03 and 0.12 percent of the land area is permeable, respectively. It is believed that this method provides a spatial explicit tool to help designers, planners, and managers prioritize urban greenspaces for the ecological processes of forest migration.

**Keywords:** Forest migration, climate change, city, urban greenspaces, permeability

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# The potential influence of nursery offerings on tree species diversity in new Beijing plain afforestation

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Nursery offerings is one of the key drivers of urban tree community composition and diversity. There is a tight connection between tree attributes that resident prefer and tree attributes that nursery tree species have. Beijing plain afforestation project had built one million mu (Chinese unit for area, equivalent to 0.0667 ha) greenspace in three years lasted from 2012 to 2014. The implementation rules of this project required that the distance of nursery offerings from Beijing should be less than 600 kilometers. Finally, there were 54 million trees being planted including 77 tree species and 99 shrub species. Recently, Beijing will initiate another million mu afforestation project aiming at raising the forest cover rate to 45%. The forest cover rate for plain region will be 35%. Trees with attributes like native, longevity, endurance, feeding and beauty will be planted in cities, shallow mountain areas and plain regions. A great many of trees will be needed with no doubt. But how many tree species could nurseries offer is unknown. We investigated tree species in nurseries from four provinces with distances less than 600 kilometers from Beijing. They are Shandong, Hebei, Shanxi and Liaoning provinces. Data was obtained from tree selling advertisements on a website (<http://www.miaomu.com>). This website was built in 2000 and is one top platform for selling seedlings. Tree species, growth traits, price and nursery names were recorded from advertisements in 2018. We collected tree species data from 285 nurseries belonging to companies and individuals. There were 165 tree species. However, only several species were mostly grown such as *Sophora japonica*, *Fraxinus chinensis* and *Platanus orientalis*. There many native species of local plant community are not grown in nurseries. In conclusion, Beijing plain afforestation should pay more attention to the tree species diversity in nurseries.

**Keywords:** Beijing plain afforestation, nursery offering, tree species diversity,

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# **Indirect root distribution detection by 2D Electrical Resistivity Tomography. Application to Pinus pinea root system, in different soil type with a field approach**

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In order to quantify the radical cohesion, in slope stability analysis application, some kind of root presence measurement is mandatory, and usually it is used the root area ratio (RAR). Mainly, RAR is obtained by a direct analysis of the root system, but this method is very expensive, destructible and not replicable. The aim of this study is the development of an indirect survey able to quantify RAR. For this purpose, 2D Electrical Resistivity Tomography (ERT, hereinafter) has been lead on 8 stone pines in two different soil type (sand and clay loam), with a double approach: (I) high-resolution comparison of RAR and resistivity value and (II) comparison of the distribution in depth of these two parameters. During the surveys, in order to modify the water content of soil, irrigation water was added. Results show a high correlation between RAR and resistivity (or conductivity), with a different trend in relation to the soil type and the soil moisture. The resistivity variation can predict the mean rooting depth. For a better understanding of the relationships between RAR and soil resistivity, in situ 3D ERT and a laboratory approach are needed. This approach can be useful for assessment of trees in urban environment.

**Keywords:** Root area ratio, Geophysical application, Slope stability, Radical cohesion, Soil water content.

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# A fast and ultra-spatially resolved method to monitor PM concentration in cities from PM deposition on urban trees

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Monitoring the amount and composition of airborne particulate matter (PM) in the urban environment is a crucial aspect to guarantee citizen health. To focus the action of stakeholders in limiting air pollution, fast and highly spatially resolved methods for monitoring PM are required. Such monitoring should provide both quantity and quality of the particulates, in order to identify the pollution sources and take specific and more efficient actions. The importance of PM removal from urban air by deposition to trees is a well assessed issue. Recently, the tree PM capturing capability inspired the development of several methods intended to use trees as biomonitors; this results in the potential of having an ultra-spatially resolved network of low-cost PM monitoring stations throughout cities, without the needing of on-site stations. Within this context, we propose a fast and reliable method to qualitatively and quantitatively characterize the PM present in urban air based on the analysis of tree leaves by scanning electron microscope combined with X-ray spectroscopy (SEM/EDX). We have tested our method in two different experimental sites, located in the cities of Naples and Terni, as a function on the wind direction and the tree species, respectively. The quantitative results obtained from the SEM/EDX analysis for PM<sub>10</sub> and PM<sub>2.5</sub> masses have been validated by measuring the mass of the PM washed from leaves belonging to the same sample sets. The qualitative results (i.e., PM size distribution and elemental composition) match appropriately with the known pollution sources in the sample sites (i.e., traffic, marine aerosol and steel industry). A detailed analysis of the leaf morphology has further allowed to discriminate the 17 tested species based on their suitability to be used as biomonitors; this is a crucial information for the future planning of highly spatially resolved biomonitoring network based on trees in urban environment.

**Keywords:** Air pollution; Human health; Particulate matter; Urban trees; SEM-EDX

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## Urban and peri-urban vegetation can improve air quality in Mediterranean areas

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Air pollution is a major environmental problem in most cities across the world. Meanwhile air quality policies succeed in drastically decrease emissions, cities need to develop strategies to reduce the population exposure to air pollution, in order to minimize the effects and the enormous economic costs associated, and to improve the environmental quality and citizen well-being. Air pollutants can be removed from the atmosphere through both wet and dry deposition. In Mediterranean environments, atmospheric deposition is dominated by dry deposition processes. Urban and peri-urban vegetation, through interception in the canopy surfaces, and via absorption of gases through the stomata, can increase dry deposition, representing a valuable tool for improving urban air quality and reduce exposure of population to air pollution. In this work, the capacity of urban vegetation to remove air pollutants has been assessed combining experimental measurements and model estimations. Experimental data showed that in areas without emission sources (peri-urban forests, big parks), the concentrations of NO<sub>2</sub>, NH<sub>3</sub>, HNO<sub>3</sub> and O<sub>3</sub> were significantly lower below tree canopies than in open areas without trees. These results highlight the importance of the presence of trees in sensitive areas (playgrounds, schools, sports areas, hospital gardens, homes for the elderly, etc) to reduce the exposure of sensitive population to air pollution. Measurements and Computational Fluid Dynamic (CFD) models have proved the efficiency of hedges at stopping the dispersion of pollutants linked to the traffic, showing a reduction of black carbon concentrations. The combination of measurements and CFD models are needed to understand the influence of trees in air pollution dispersion in street canyons. Roadside trees can reduce the vertical dispersion of pollutants emitted by traffic, which may worsen the air quality, but trees can also act as a horizontal barrier avoiding the entry of pollutants emitted in nearby streets with heavy traffic.

**Keywords:** air pollution, urban vegetation, vegetation barriers

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# The rise of urban agroforestry systems – a comparative analysis of the United States/Canada and Germany

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Use of modern agroforestry systems in urban areas is on the rise. Alternative uses for public space through urban gardening projects have existed in North America since at least the 1970s and 1990s in Europe. More recently, some projects have started including shrubs and trees to provide food, environmental services, personal recreation, and bioenergy. To date there has been little research on the factors that enhance or inhibit the diffusion of such projects. 62 urban agroforestry projects in USA/Canada and 24 projects in Germany were found through a systematic online search. Whereas the first projects in North America started in 1998 and reached a peak in 2011 followed by a slump in numbers after 2015, the trend started considerably later in Germany around 2005. Similarly the peak was around 2011/12 in Germany; however, since that time new projects have emerged every year. Based on Roger's theory of the Diffusion of Innovation, which divides trends according to distinct phases – knowledge – persuasion – decision, and confirmation, 12 criteria were developed to evaluate and rank the projects according to their phase. To some degree, this ranking reflects the stage of development and possible sources for user-experience. Mapping of project diffusion over time indicates that they largely started in major cities with universities, primarily on USA's West Coast. Detailed analysis of six selected projects and expert interviews provided rich insights into their development, as well as obstacles and needs of stakeholders. Important for success is the role of experts especially during the establishment phase. Not solely experts for trees and plants, but also with civic management expertise. A number of legal constraints are experienced, and prejudices and initial distrust by locals was common throughout the course of project implementation. Newly established urban agroforestry projects need broad community support. Networking between projects is also essential for lasting success.

**Keywords:** urban agroforestry, urban planning, community food forests, Diffusion of Innovation

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## PS 5.4: Changing Benefits – *Chaired by Josefina Enfedaque*

### **Landscape Health Assessment Index: A Methodological Summary of Soundscape Mapping as a New Frontier for Urban Forest Soundscape-Based Spatial Planning Design, and Ecological Security Pattern and Geometry Recognition**

*Charl Justine Darapisa*

### **Using ecosystem service knowledge to design innovative performance-based urban planning approaches**

*Davide Geneletti, Chiara Cortinovis*

### **Methodologies and results of monitoring activities in lowland forests and urban plantations in lombardy and Slovenia**

*Calvo E., Barbante E., Sanesi G., Colangelo G., Verljc A., Vilhar U., Gini R., Selleri B.*

### **i-Tree: Assessing changes in urban forest benefits and values across the world**

*David J. Nowak*

### **Self-watering Vertical Planter: Solution for Green Facade in Tropics**

*Rosniza Kassim, Rohazrin Mohd Rani, Mohd Abid Ahmad & Ab Kahar Sandrang*

### **Breathing in the Parks: an innovative tool to plan low-allergy urban forests in the future**

*Paloma Cariñanos*

### **Ecotourism and environmental education potentials in urban forests of Malaysia**

*Noor Azlin Yahya*

### **Integration of fundamental principles and applications of emerging techniques in urban forestry**

*Nancai Pei, Cheng Wang, Bufeng Chen, Ruilin Sun, Xinhui Xu, Xin Shi, Juyang Liao, Jianrong Li, Linping Zhang Zhiqiang Zhang, Lin Gu, Zezhou Hao, Baoquan Jia, Erfa Qiu, Chang Zhang, Zhenkai Sun, Shasha Jiang, Wenjun Duan, Na Luo, W. John Kress, Cecil C. Konijnendijk van den Bosch*

# **Landscape Health Assessment Index: A Methodological Summary of Soundscape Mapping as a New Frontier for Urban Forest Soundscape-Based Spatial Planning Design, and Ecological Security Pattern and Geometry Recognition**

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*Philippine Association of Landscape Architects*

Unwanted sound in the urban areas can very much damage one's psychological health like hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances and other harmful effects; but recent studies also concluded that it can also produce detrimental changes to animals in various behavioral and morphological ways. Specifically, urban noises pose biological changes of animals like increased heart rate, body shifting and wastage of stored energy, panic and escape behavior, avoidance of habitat and unattractiveness to mate (Radle, 2007). From all of these, the need to study and preserve natural soundscape in urban areas comes into essential play. The evaluation of the ecological significance of an area can be undertaken from different perspectives and consequently with different objectives. Since sounds are a perpetual and dynamic property of all landscapes, the researcher attempted to devise a new landscape health assessment index that will measure ecological significance of a particular landscape. With high hopes, the focus of finding a new landscape measuring tool allows this research to come up with indices that can be applied to various ecological typologies and situations in both urban and rural areas. The researcher utilized sounds present in a landscape to come up with new landscape assessment method that can make the work faster, more efficient and would require less energy and time. Preserving natural soundscape, as an integral attempt of this research will bring new landscape architecture standards for urban spatial planning methods, formulate new design processes and strategies for wildlife conservation management, develop new soundscape-based urban green design permutations, and most importantly understanding ecological security patterns and landscape forest geometries to map out past, present and future soundscape ecological significance and potential services.

**Keywords:** Soundscape Mapping Design, Urban Forest Spatial Geometry Recognition, Ecological Security Patterns, Natural Soundscape Preservation, Landscape Health Assessment

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# Using ecosystem service knowledge to design innovative performance-based urban planning approaches

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The relevance of ecosystem service knowledge to urban planning is widely recognized, and the usability of methods and tools to assess ecosystem services is rapidly increasing, to the point that, in few years, they could be routinely adopted by planners and public administrations. However, mechanisms and procedures to include ecosystem service assessments as an integral part of the planning process are yet to be explored. This research aims to test the use of ecosystem service assessments to design innovative performance-based planning approaches, by explicitly considering the distribution of the expected benefits of green urban infrastructures to different groups of citizens. The ongoing revision of the urban plan of Trento is used as a testbed, giving the opportunity of collecting feedbacks on the proposed approaches from local practitioners and decision-makers. Different options for integrating the results of ecosystem service assessments in the definition of required performances for future interventions (including urban regeneration and green infrastructure enhancement schemes) are described and discussed. The options range from designing compensation schemes based on the expected impacts of planning interventions on ecosystem service supply, to more complex approaches where the required performances are tailored to the existing types and levels of demand in the different parts of the city. The research highlights the potential of innovative performance-based approaches grounded on ecosystem service knowledge to enhance current planning standards, by strengthening their link to planning objectives and by promoting a more site-specific application. Limitations and potential risks of the proposed approaches, mostly related to their complexity and the associated management burden for local administrations, are also discussed.

**Keywords:** urban green infrastructure; ecosystem services; urban planning; beneficiaries

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## Methodologies and results of monitoring activities in lowland forests and urban plantations in lombardy and Slovenia

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The role of urban and periurban forests is now widely recognized in ensuring good ecological conditions for urban ecosystems, quality of life for the mitigation of climate excesses and pollution phenomena and physical and mental well-being for urban population. However, organic and sustainable policies do not seem to be widespread for the development and management in the territory and in the cities of these forest patrimony which, due to their territorial location, the type of impacts and stress to which they are subjected, the specificity of ecosystem services that are they are required, constitute a unique and particular ecosystem. Monitoring urban and peri-urban forests is therefore an instrument not only to better understand the entities, distribution and health status of these formations, but also to better understand the dynamics, evolutions and services rendered to define, apply and verify the policies adopted. The LIFE + EMoNFUr Project, developed in the years 2011-2014, has elaborated and applied a monitoring model that concerns the silvicultural aspects, biodiversity, pathology, soil and perception. The project intends to illustrate the model and its application in urban forests in Lombardy and in Slovenia, with the main results achieved, and to define the modality of its adoption and long-term application in Lombardy.

**Key words:** Monitoring, urban forests, inventory

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## **i-Tree: Assessing changes in urban forest benefits and values across the world**

*David J. Nowak\**  
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Urban trees and forests provide numerous benefits, yet cities tend to know relatively little about this important resource. To help citizens and land managers better understand and value their local urban forest resource, a series of free tools have been developed. This suite of tools, known as i-Tree ([www.itreetools.org](http://www.itreetools.org)), was developed by the US Forest Service, Davey Tree and other partners to aid in improved urban forest management to sustain forest and human health for current and future generations. To date, there have been over 250,000 i-Tree users in 131 countries. The core i-Tree tool is i-Tree Eco. This tool uses sample or inventory data to assess forest structure, ecosystem services and values for any tree population (including number of trees, diameter distribution, leaf area, species diversity, air pollution removal and health effects, carbon storage and sequestration, runoff reduction, VOC emissions, UV radiation reduction, building energy effects). The program is designed to readily work in the United States, Canada, Australia and the United Kingdom, with 2018 updates to include Mexico, Europe and Colombia. For other countries, i-Tree Database can be used to enable i-Tree Eco for their area. i-Tree Eco includes plot selection programs, data entry programs or mobile application data entry, table and graphic reporting and exporting, automatic report generation and the ability to forecast future tree population totals, canopy cover, and ecosystem services and values by species. This presentation will overview i-Tree Eco and several other i-Tree tools that can be used globally to facilitate tool use, collaboration and development across the world.

**Keywords:** forest benefits, forest values, forest assessments, computer tools, species selection

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## Self-watering Vertical Planter: Solution for Green Facade in Tropics

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Vertical planting is one of the latest planting technique introduced for urban farming activities. The vertical planting technique is an alternative to conventional planting technique that usually using beds or pots. Through vertical planting system, edible and ornamental plants can be planted in limited spaces. The technology for vertical planting is actually widely leaded by developed countries such as the UK, USA, Korea, Japan and Australia. Most of these planting systems are designed to suit their climate and their needs. The vertical planting systems that widely used in Malaysia are mostly imported from the countries and this makes the cost of the systems increase and affects the purchase decision of the urban residents. Additionally, vertical planting system requires a relatively complicated watering system to ensure the watering fully automated. This is one of the barrier factors for urban residents to implement this system at their premises. Another most common issue that found in vertical planting system is uneven watering spread due to gravity action. Plants that planted in the lower level received more water compare to the higher level; this situation affects the plants performance and the maintenance of the planting system. Besides that, Malaysia located in Tropical region which has received abundance of rain water throughout the year. Self-watering mechanism can be the best solution for vertical planting in Tropical region. Vertical planter with self-watering system being developed to solve the maintenance & high cost issues in vertical planting system especially in Malaysia.

**Keywords:** Green wall, vertical planting, vertical garden, green facade, tropical planting

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## **Breathing in the Parks: an innovative tool to plan low-allergy urban forests in the future.**

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Urban forests (UF) provide a series of ecosystem services (ES) that have direct and indirect effects on public health. However, up to 30% of the world's urban population may have an impact on their quality of life due to allergens emitted by some common urban tree species. Approximately 30% of the world population is affected by allergic reactions caused by the presence of pollen grains in the atmosphere. In Europe, more than 150 million citizens suffer from chronic allergic diseases, with an estimated cost for National Health Services of between 55 to 151 billion euros year<sup>-1</sup>. Among the causes that have generated a growing allergenicity in urban environments have been the low biodiversity of UF-forming species, the incorporation of exotic species that have become new allergens, the interaction with urban pollutants or the botanical gender imbalanced, but above all these causes it highlights the lack of planning in the selection of species and in the design of urban forests. In this context, the Breathing in the Parks initiative has established a series of guidelines and tools aimed at minimizing the impact of allergen emissions on the population through the design of sustainable and healthy urban forests. One of the objectives of this project, established in Spain and then extended to other countries in Mediterranean Europe, has been to classify the potential allergenicity of more than 400 urban tree species, based on a series of intrinsic and biometric parameters to the species themselves. The transfer of this information to any element of urban forests allows assessing the allergenic risk that this space can have on the health of the population. This innovative tool could be a first approach towards planning and designing low and allergy-friendly UFs of the future.

**Keywords:** Ecosystem Disservices, Cost of Greening, Allergens

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# Ecotourism and environmental education potentials in urban forests of Malaysia

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Urban forest is known to provide many sociological and socio-economic benefits. Urban forests often treated as valuable assets where even properties are evaluated at higher price when located close to urban forest or park. However, urban forests need to be managed well to enable them to provide benefits to the urban residence. This paper starts with discussion on the challenges of urban forest management in Malaysia and propose some ways for improvements. Research and monitoring are continuously needed to encourage urban green establishment. In Malaysia, collaborations between different types of organisations are being forged, for example between local governments and research institutes and some of these smart partnerships will be highlighted. This paper will also proposed urban ecotourism as a tool to encourage conservation and education. To conserve Malaysian biodiversity, indigenous species are recommended to be planted in the urban areas to become sources of education and for attracting tourist to learn about Malaysian heritage. An example of potential ecotourism products in urban forest will be the final highlight of this paper.

**Keywords:** Urban forestry; environmental education, landscaping, arboriculture, urban tourism

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# Integration of fundamental principles and applications of emerging techniques in urban forestry

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Modern forestry has been developing towards a cross-disciplinary, multi-functional, and highly technological endeavor under rapid urbanization worldwide. In this paper, we propose a conceptual framework for a comprehensive approach to urban forestry, consisting of forest, landscape and ecosystem dimensions. We further offer a “two-pronged” pathway of emerging techniques related to assessing and understanding urban forest ecosystems; specifically, 1) spatial-level techniques, which include assessment of forest canopy, understory, and belowground functions, and 2) organismal-level techniques involving micro-, meso-, and macro- components of forests. Finally, we present an empirical case study on describing China’s experience and mode of urban forestry. Urban forestry in China has developed rapidly, incorporating some fundamental principles and adopting several emerging techniques which may inspire urban forest researchers, decision makers, and managers in other countries or regions. Learning from the Chinese experience can help to advance modern urban forestry across the globe.

**Keywords:** Anthropocene, Forest biology, Global change, Terrestrial ecosystem, Urbanization

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# POSTERS

## The Past – *Changing Spaces and Places*



# **Gwangju Urban Greenery Syntax: Anatomizing Gwangju City's Urban Greeneries to Articulate Urban Park Design Syntax Using Unconscious Perceptive and Predictive Landscape Analysis**

*Charl Justine B. Darapisa\**

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Design syntax, a term inspired by Archana Sharma which implies the composites of spaces with reference to the resultant spatial form, encouraged the researcher to deal with articulating the anatomy and city greeneries to further understand landscape success and functionality. Whether multiple functions or singularity designs, a fundamental aspect of dissecting how a particular urban parks can be successful in providing services have been questioned in the field of landscape architecture. Whether ecological, cultural, historical and industrial landscapes, a critical gap of inquiry is acknowledged regarding the lack of design grammar and syntax to operationalize landscape spaces. This research study revolves around deriving specific measuring tools on how landscape spaces success can be measured using Unconscious Perceptive and Predictive Landscape Analysis, both specifically coined by the researcher. The researcher's Unconscious Perceptive Analysis (UPA) was inspired by the view offered by William James that articulates in the framework of contemporary functionalist accounts of mental qualities and higher order theories. The researcher assumed that perceptions derived from spaces could be hardly measured; but by analyzing users' movements, consumption of spaces, visual scope, continuity of usage, directionality, motion awareness, landscape contrast and saturation, usage of joints and nodes can all be used to organize, assess and design forms, patterns, and geometry of urban parks. On the other hand, Predictive Landscape Analysis (PLA) can be further applied once design syntax and grammars have been understood using the Uncoscious Perceptive Analysis. While UPA measures usages of spaces using different human perceptions, PLA uses multiple mixed-method approaches such as mathematics-based graph studies to analyze aerial patterns and shapes, photography-based thermal analysis, material and morphology studies and section-elevation analyses that can offer future fundamental design grammar and syntax in the field of landscape architecture especially city greenways.

**Keywords:** Urban Parks Design Syntax, Landscape Functionality and Success, Landscape Assessment Tool, Urban Park Standards and Design Development

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## The Past – *Changing Environment*

## Heavy metal absorption characteristics of European Ash in conditions of Yerevan (Armenia)

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This paper provides both the results from a decade-long (2007 through 2016) monitoring of the heavy metal uptake potential of *Fraxinus excelsior* L. (European ash-tree)-one of most widespread native tree species involved in the green infrastructure of Yerevan – Armenia's capital city, and the studied tree species condition assessment data. Ash-tree leaves were gathered throughout the city and then underwent lab pretreatment at the Center for Ecological-Noosphere Studies NAS RA. Measurements of contents of ten heavy metals: Pb, Hg, Ni, Mo, Cu, Zn, Mn, Cr, Sn, Ag in the leaf samples were done by the accepted atomic absorption method. One of major results generated from this research is that *F. excelsior* best takes up Pb, Ni, Mo, Hg and that over the studied period Ni and Mo remained persistently in the list of priority pollutants of urban ash-trees. Besides, the research allowed establishing a regularity of dynamic changes in Pb and Hg uptake by ash tree leaves. According to assessment data, condition of ash tree specimens involved in the green infrastructure of Yerevan is assessed as good. Collating between long-term data on heavy metal uptake by ash tree leaves and those on the studied tree species condition assessment has indicated that under the impact of diverse environmental factors *F. excelsior* is best tolerant to Yerevan's conditions and has a high heavy metal uptake potential. The obtained research results are intended for organizations involved in urban forestry and urban planning, etc. in Yerevan and other urban settlements enjoying similar environmental conditions.

**Keywords:** *Fraxinus excelsior*, heavy metal, green infrastructure

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# LANDSCAPE ECOLOGICAL URBANISM: EFFECTIVE STRATEGY FOR RESILIENT CITIES

## How can landscape design be integrated in urban planning, reshaping urbanity and creating a new environmental scenery? The case study of Ravenna

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The objective of the contribution is to understand how Landscape design can be integrated in the urban planning, through a multi-scale approach able to remodel the city and by creating a new urban scenery that comes from the territorial and cultural uniqueness of the intervention's context, being at the same time able to fulfil the global challenges (for example, how cities adapt to climate changes) that contemporary cities are called upon to give urgent answers to, in terms of urban resilience's improvement through actions of adaptation and mitigation. The present debate on the settlement of agreements, guidelines and Best Management Practices to reduce the negative relapses of the anthropic development orients the strategies of redesigning cities starting with the integration of landscape ecological design in the urbanized space's planning. The goal is to avoid, minimize and manage better the environmental impacts brought by urbanization, following a process of sustainable planning and guarding the ecology and the specificities of the landscape, understood in its environmental and cultural meaning, in response to the goals established by international agreements. In support of the hypotheses, is presented the case study of the Urban Planning in Ravenna (Italy), which for decades has guided the planning policies towards design actions able to create physical and ecological connections between the city and the territory. Specifically, we will talk about: the Green System Plan (1992-on going, winner of the City and Landscape Award 2017) through implementing urban forestation and stormwater management; the integration into the territory of landfills in environmentally sensitive sites and the management of the retro-coastal fringes. The result is the possibility of coexisting, in a systemic and programmatic vision, the anthropic development with the preservation and implementation of environmental ecosystems through landscape ecology design approach and urban forestation, making the city resilient and ecological.

**Keywords:** Landscape, Ecology, Urbanism, Resilience, Forestation

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## The Present – *Changing People*

## Beyond Trees: Growing international stewards in non-traditional ways

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Green infrastructure is one dimension in a basket of solutions needed to address the pressures associated with urban population growth. The dominant narrative in urban forestry focuses on trees and technical applied practice. We need better, more transdisciplinary engagement among professionals who can collaborate across multiple scales to build democracy, neighbourhood pride and unity, ecological literacy and market innovation. Engaging communities through stewardship, partnership building, and conservation education are methods employed to do this. The US Forest Service International Programs and its partners understand the power of building networks and working collaboratively across landscapes and borders. For nearly 20 years, International Programs has brought together natural resource professionals from around the world to participate in intensive and interactive seminars, each of which focuses on a specific topic. The idea is to build a growing network of practitioners to share experiences and knowledge beyond trees focusing on the more social components. In June of 2017, the US Forest Service launched the first annual International Seminar on Urban Forestry that took place in Chicago and NYC. Nineteen participants from sixteen countries spent two weeks examining various non-traditional methodologies, tools, and partnerships and how these can be effective in improving lives of urban communities. From the 2017 urban forestry testimonials, main takeaways included: a) engaging communities where they live to foster youth development and community stewardship; b) facilitating access to food, education, and community greenspaces; and c) collaborating locally and globally to achieve common goals. This presentation will provide an overview of these narratives and how they have been applied both within the United States and abroad. For an introductory video, please visit: <https://youtube.com/fFsR406GYkQ>

**Keywords:** community engagement, cross-cultural collaboration, partnerships, urban forestry

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## **The experience of the Municipality of Brentonico in the management of the "Cesare Battisti" City Park: use of different tools (from EMAS environmental certification to Visual Tree Assessment and Life Cycle Thinking) to obtain the best environmental-social-economic balance.**

*Francesco Baldoni<sup>1\*</sup>, Valeria Bettini<sup>1</sup>, Giuseppe Mazzurana<sup>2</sup>, Graziano Valle<sup>2</sup>, Alessandra Astolfi<sup>2</sup>*

*1. EMAS Verifier and Esalex srl*

*2. Municipality of Brentonico*

Brentonico is a little town in Italy (4.000 people) characterized by mountain and green area around and a little activity in tourism, that we hope to grow more. The historic centre has a important city park, useful for everybody wants to stay in contact with green and fresh air, especially in summer, when lots of people come to stay and have holiday.

- 1) To manage all environmental matter, some years ago Brentonico municipality decided to apply an environmental management system, EMAS certified, based on planning all activities, green aspects monitoring, strictly law respect and external communication: EMAS Declaration is a periodical document, validated by a third part, that explain state of the art of all green activity performed by municipality, expressed in environmental performance. One of eco-priorities in past time was the city park management: big trees, excellent in summer but unfortunately some of them starting to be sick.
- 2) So Municipality decided to know better what was the problem and its extension and started an activity of Visual Tree Assessment, that allows to identify sick trees that cannot be rescued. Much more data were obtained to discuss the better action to be taken.
- 3) We are trying to apply qualitative LCA consideration (i.e.: Life Cycle Thinking), to define the best balance according to environmental-social-economic point of view.

We think that only a multivision approach based on an effective and tempestive management system can help a Municipality to do the best choice and to spend resources in a sustanaibility way.

**Keywords:** environmental management system, EMAS. Visual Tree Assessment, Life Cycle Thinking, city governance

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## Cost and productivity of urban trees maintaining by climbing arborists

*Pietro Gallo, Giulio Sperandio, Giancarlo Imperi, Tullio Guglielmelli, Marcello Biocca\**  
*CREA, Centro di ricerca ingegneria e trasformazioni agroalimentari*

In recent years, the techniques funded on rope-based access to the tree canopy (the so-called tree-climbing), have been spreading in Italy. These methods allow to operate on trees placed in any location, resulting extremely suitable for trees grown in urban environment. This study evaluated the productivity and costs of pruning and felling procedures operated by professional climbing arborists. Overall, 8 work sites were sampled with time studies. Work time was measured for every single phase, using centesimal stopwatches and video recording. Total observation time amounted to 30.36 hours, during which 2 trees were felled and 6 trees were pruned. Based on work times and biomass weight, the work productivity was then calculated. The evaluation of the operating costs of each work site was carried out by means of an analytical method, considering the fixed costs, the variable costs and the costs for the labor force. The work time analysis showed that the preparation of the work site during pruning operations, was a critical phase, reaching up to 45% of the gross work time (average 29%). In relation to the two different operations, pruning and felling, the results showed that the average gross time of the work sites was 3.34 and 6.00 h/t, respectively, with an average productivity of: 0.33 for pruning and 0.19 for cutting operation, obtaining an average cost respectively of 159,24 and 269,09 €/t. This paper can contribute to optimize the operations of caring and maintaining trees in urban sites using tree-climbing methods.

**Keywords:** tree-climbing, costs, maintenance, pruning, felling

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## **Parchi Collaborativi: new forms of social activation**

*Marco Pollastri, Riccardo Mercuri\**  
*Università Verde di Bologna - Centro Antartide*

Our country's landscape heritage comes from history's sequences, from a form of geography promoting open spaces and particular attention and care in linking the urbanized with its surroundings. Today, enhancing good quality open spaces is an unavoidable necessity from which urban areas can no longer escape. It means the reaffirmation and growing demand of open spaces, green and liveable. Climate change and environmental urban conditions put green spaces as one of the main answer to climate change resilience. Equipping our open areas with green infrastructures would allow to alleviate these concerns, offering at the same time sustainable and ecological alternatives for urban development. In addition to climate motivations, green spaces play a fundamental role in our cities' social structure. The attention to "life between buildings" (J. Gehl) has crucial importance in urban regeneration processes and allows to give essential guidelines in order to promote a more "humanistic planning" approach. The "Parchi collaborativi" project, realized in Bologna by Centro Antartide with Municipality and the private companies who manage the public green areas, aims at finding new forms of green spaces vitalization. It promotes hands-on green spaces' care as an instrument and not a goal, in order to build share capital. An intergenerational and multiethnic meeting space where to experiment educational methods regarding common good and strengthening social cohesion. An important aspect is that the project has been written in the proposal presented by the private companies during the tender procedure for the Municipality green public areas management. From this perspective, green spaces offer many occasions to incentivize interaction, sharing and cultural growth, and contexts to live in safety. Creating new social networks that could start from taking care of green public spaces in a participatory and collaborative way, could be one of the paths to head towards good quality and safe green spaces.

**Keywords:** vitalization, share capital, education, parks, urban

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## **Green book of lombard forests": expectations and evaluations of operators and public in respect of urban forests in Lombardy**

*Enrico Calvo*  
*ERSAF Lombardia*

During 2017 ERSAF promoted and implemented a participation process for the definition and evaluation of forest policies, including those for urban forests. 10 thematic meetings were organized in the region and more than 1000 questionnaires were collected, which allowed assessing, on the one hand, the degree of knowledge and awareness of the public and operators regarding the role and value of urban forests, and on the other to identify critical issues, priorities and perspectives to implement policies aimed at enhancing the long-term urban forests. The poster intends to represent the results of this process that have been collected in the "Green Book of Lombard Forests"

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# **Co-creation and experiential learning of climate change and urban forest at the neighbourhood block scale – A Canadian experiment on engaging and mobilizing citizens on building a greener community**

*Zhaohua Cheng\*, Stephen Sheppard, Doris Sun, Jennifer Reid*

*Collaborative for Advanced Landscape Planning, Faculty of Forestry, University of British Columbia*

A healthy urban forest is key to make our cities more sustainable and happier. However, our urban forests are usually susceptible to climate change impacts, urbanization and densification. Many cities nowadays, like Vancouver in Canada, are experiencing declining tree canopy. Maintaining and improving our urban forests, we will need to involve and mobilize more citizens, due to the key roles of private land and public support for municipal management efforts. Although effective stewardship programs exist, they tend not to reach the silent majority who controls the private section of urban forests. In order to more effectively reach the under-engaged in everyday residential neighborhoods, build climate literacy, and stimulate engagement, we need an engaging, interactive process that uses place attachment, peer sharing, and experiential learning to motivate collective action. The presentation will introduce a novel engagement tool, the Citizen's Toolkit on Climate Change and Urban Forestry ('Toolkit' for short), as an example that draws on these principles to create an engaging process for building citizen's literacy and resilience. The Toolkit includes compelling visuals and fun 'do-it-yourself' exercises for friends and neighbours to gain a better understanding of the values of urban forests/trees on their block, and action that they can do in daily life to build a more sustainable and cohesive community. It includes place-based hands-on exercises for experiential learning in an outdoor environment (e.g. which tree provide the most shade for cooling in my street). It also encourages peer sharing and comparing with friends and neighbours to prompt discussion and behaviour change (e.g. which neighbour's house is the most tree-friendly and climate-proof). Activities are organized in a 5-step process: starting a conversation; mapping the block; rating the block; future visioning; and action planning. Early testing results with local citizens and high-school students, and directions for further research will be outlined

**Keywords:** Novel engagement tools, climate change solutions, urban forests, citizen engagement, resilience building

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## Urban Forest vs. Economic Growth: the case of Johannesburg, South Africa

*Markus Scheuermaier\*, Andrea Rosen  
Johannesburg Urban Forest Alliance*

Johannesburg is the largest metropolitan areas in South Africa, with about 5m people, and is currently undergoing rapid demographic, economic and spatial change. Yet, the city is also home to one of the world's largest urban forests that is now under threat from redevelopment by the municipal government. How can one reconcile the importance of urban trees versus the need for economic growth in one of the most unequal societies in the world? The presentation will discuss the experience of the Johannesburg Urban Forest Alliance (JUFA), an umbrella organisation of residents', environmental and heritage associations from across the city. The challenges discussed will be three-fold:

1. Economic redress vs. environmental sustainability - Johannesburg is the archetypical apartheid city, with wealthier - formerly white - areas mostly to the north, and poorer - mostly black - areas elsewhere, with a central business district in the middle. A fundamental spatial reorganisation is required, but JUFA has been arguing that it is in the interest of the city to harness its urban forest for better growth.
2. Indigenous vs. non-indigenous trees - most trees in Johannesburg have been imported, initially for mining purposes, and are therefore not considered valuable. Yet an urban forest has emerged over the past 100+ years that is valuable in its own right, and is different from the surrounding grasslands. But this requires a change in perception, which JUFA has been lobbying for.
3. Public vs. private spaces - Johannesburg has been largely designed for car usage, to the detriment of public spaces. If the city is to become more integrated, trees will be an essential component for civic interaction - JUFA has again been arguing that it is their presence that allows residents to congregate in spaces that are open, yet sheltered from the harsh Southern African sun and climate.

**Keywords:** Inequality; Sustainability; Integration

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## Declaring trees as environmental patrimony - São Carlos/SP (Brazil) case study

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Historically, the process of implementing urban settlements has in one of the first stages, the removal of the local vegetation cover, for later adjustments of the land. This practice entails a set of impacts on the environment are presented, which present themselves as the major problem of contemporary urban centers. This set of impacts modifies the local ecosystem and promotes diverse stress scenarios in the local population. Trees are elements that enhance urban quality of life by providing various ecological, social and economic services. To protect trees that already exists, the city of São Carlos (Brazil) declared various trees as environmental patrimony. The objective of this study was to analyze the history of this strategy in order to understand the variables that influence to the improvement of this public policy. 35 trees were identified as environmental patrimony by means of 6 decrees. The reasons for preservation are diverse and show intense historical, cultural, spatial and ecological relations between community and trees. The main reasons for preservation were: Beauty; Age and Cultural relation. It stands out from the set of decrees, the number 133 of 2001, which declares immune of cut the species *Araucaria angustifolia*. Another observation is related to the temporal scale. All the trees declared as environmental patrimony occurred during the years 2001 to 2007, when the same political group was at the head of the municipal administration, demonstrating that this strategy was more a government policy than a state policy. It is concluded that this strategy of declaring trees as environmental patrimony represents an advance in the management of the urban forest because it represents a strong link between the local community and the arboreal individuals. However it needs to deepen political interest, since for more than 10 years no other tree is declared.

**Keywords:** urban forest; environmental patrimony; urban trees; urban forest policy; urban forest planning

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## The Present – *Changing Spaces and Places*

# Assessing greenspaces in built-up areas of Italy to support large-scale policy and planning

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Despite the key role played by greenspaces in built-up areas (GSB) to support human health and wellbeing, accurate and reliable data on their abundance and characteristics are still often missing. We specifically refer to built-up instead of urban areas in order to include both road infrastructures and sparse settlements not negligible in contexts dominated by the urban sprawl phenomenon such as Italy. Accordingly, the aim of this study is to estimate the abundance, extension and average size of such elements through the integration of inventory and cartographic approaches. GSB estimated characteristics are also analyzed in relation to the presence or absence of trees as well as to their crown coverage. Finally, their distribution according to the population density is evaluated. Results show that 43.5% of built-up areas in Italy is unsealed, of which more than 18% is covered by GSB. GSB are fairly dominated by forests (92%) with a decreasing trend in canopy cover with the increase of population density. GSB smaller than 0.5 ha are widespread in densely populated contexts while largest GSB patches are mostly located in thinly populated ones. This distribution contributes to the largest availability of GSB per capita in the latter respect to the former (72 and 9 m<sup>2</sup> per inhabitant, respectively), with an average national value of 27 m<sup>2</sup> per inhabitant. Our approach and findings have proven to be suitable in providing reliable large-scale estimates to support the implementation of Nature-Based Solutions along an urban-rural gradient as well as the large-scale strategic planning of green infrastructures.

**Keywords:** land inventory, statistical sampling, green infrastructures, nature-based solutions, urban planning

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## **The project ‘Productive Green Infrastructure for post-industrial urban regeneration’: the case study of Turin (Italy)**

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*2. City of Turin*

The Turin Municipality is the lead partner of the Turin front runner city in the PROGIREG H2020 project starting in 2018. With a huge list of participants, from the Academia and civil society, we will test and develop models for participatory urban regeneration. The study area is the post-industrial “Mirafiori Sud” district (40 000 inhab. on 12 km<sup>2</sup>) which is located along the river Sangone, characterized by poor quality of the urban environment accompanied by social segregation, poverty and security problems. The main goal in Turin is to implement an urban regeneration plan with measures, activities and tools that will regenerate, valorise and make abandoned or underused areas accessible; improve the security; involve citizens and foster and support urban greening activities. A set of nature-based solutions will be implemented and monitored, such as new soil and plant species for urban forestry, urban farming and gardening, small scale GI interventions (green walls, green roofs, urban gardens), and pollinator friendly green spaces.

**Keywords:** Citizen science, nature-based solutions, biomonitoring, new soil, greening

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## **Epitaph: the forest leaves the city?**

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Mata da Izidora (Izidora Woods) is an urban forest located in Belo Horizonte, Brazil, the third largest metropolitan region of the country. It is the most extensive remnant of vegetation of this municipality that is not a conservation unit, covering an approximate area of 10,000,000 m<sup>2</sup>, and a biodiversity relative to the transition between the Atlantic Forest and Brazilian Savanna Biomes. However, Mata da Izidora is threatened because it is susceptible to complex interactions inside and outside its boundaries. In its interior, there are particular rural properties, one quilombola community and three urban occupations. In addition to the internal interactions that influence the local dynamics, the interests of the public power and the real estate sector should also be taken into account. This study main aim is to "identify possibilities for the survival of urban forest fragments through social appropriations". In order to achieve this objective, we sought to extensively present the addressed issue through documents, reports, maps, figures, semi-structured interviews and poetry. In this scenario, a problematization of the reality of space and also a dialogue with the literature were carried out with the data obtained, in order to analyze the motivations for social coexistence or not with Mata da Izidora. As a result of the possibilities identified, this work recommended the creation of a conservation unit as an alternative to reconcile some of the yearnings for the area, suggesting a Sustainable Development Reserve for the Mata da Izidora (corresponding to category VI "Protected area with sustainable use of natural resources" of the IUCN Protected Area Categories System). With the reflections and considerations exposed, this work intends to contribute to the discussions on urban forest fragments and with other possibilities for the coexistence between nature and city.

**Keywords:** Mata da Izidora, urban forest fragments, conservation unit, city, environment.

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## Feast of the Forest

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*City Government of Puerto Princesa, Philippines*

With a population of over 250,000 and an economy that is rapidly growing due to urbanization, Puerto Princesa City – a young and highly urbanized city in the Philippines is continuously challenged on how to keep up with urbanization and to ensure that sustainable development goals are addressed in the local level while concurrently mitigating impacts of climate change that threatens the environment, economy and people's well-being. Through a two-decade long environmental project called "Pista I' Ang Kageban" (Feast of the Forest) - an annual massive tree planting activity participated by all walks of life, Puerto Princesa has become a true reflection of the effectiveness of urban forestry programs in providing better future for the people. Started in 1993 where illegal loggings and other intrusive activities are rampant in the country, the City has made great strides in increasing its forest coverage with more than 300 hectares of watershed now planted with 2 million trees providing clean air and sufficient water supply to the city's growing population. This annual festival is held every last Saturday of June with a massive tree planting activity taking place with people celebrating forests with songs, music, games, and other recreational activities. More than just a tree planting activity, Pista I' Ang Kageban is a story worth sharing to the entire world which could inspire other cities to protect and conserve the environment and bring people closer to nature

**Key words:** sustainable development; reforestation; climate mitigation; watershed protection.

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## **Building resilience and sustainable cities: Diagnosis for the implementation of PMMA in the municipality of Foz de Iguazú, PR – Brazil**

*Juan Orgaz Espinoza\**

*Federal University of Latinoamerican Integration – UNILA*

The present work makes a diagnosis of the location and situation of fragments of vegetation in the municipality of Foz do Iguaçu, Brazil, evaluating the region under a spatial approach and proposing conservation measures within the framework of the Municipal Plan for the Conservation of Atlantic Forest (PMMA), a legal instrument for urban environmental planning and management. For this, a multicriterial analysis of the urban remnants of the Atlantic Forest was carried out, to define priority fragments for conservation, and to identify the main vectors of pressure on them. Georeferenced data generated by satellite and a drone were used to know the current status of the areas -previously selected- based on Urban Ecology criteria. As result of the analysis, 18 remnants of the Atlantic Forest were defined as priority areas for conservation, where different types of use are established having as a reference the classification of the National System of Conservation Units (SNUC), implementing a systemic management of the areas and its integration with the local community, among others. At the same time, it recommended the creation of Linear Parks around the urban rivers, using as argument the relevance of the water wealth in the region and the presence of springs water in the area. Finally, eight pressure vectors were identified as potential drivers of deforestation and/or environmental degradation in the city, in order to propose preventive actions and adaptation to their effects. In this sense, the proposal demonstrates the urgent need to create environmental policies that guide the municipal development guidelines, highlighting the importance of conserving the local biodiversity of the remnants of the Atlantic Forest, and, at the same time, placing the PMMA as an essential contribution to transformation the municipality to an intelligent and sustainable city.

**Keywords:** PMMA, Atlantic Forest, Urban Ecology, Conservation, Environmental Legislation

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## **Wasteland to Woodland - the Northwich Woodlands**

*Clare Olver\*, Paul Nolan; Tomoko Miyagawa  
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In 1991 twelve Community Forests were set up in England; the largest of which, The Mersey Forest, covers Merseyside and North Cheshire. All forests shared four objectives: economic regeneration, economic development, social welfare and environmental improvements. In the early days, there was large-scale reclamation of derelict land around Liverpool, St. Helens and Northwich. Over 3,000 ha of new woodland has been created and woodland cover has doubled from 4% to 8%. Northwich Woodlands in Cheshire is one such example. It is located adjacent to Northwich town centre which has a long history of salt mining, and is considered the cradle of the salt-dependent chemical industry, with the consequential blight of derelict land. Through a decade of organisations, working together in partnership, the restoration of that derelict land into a vibrant community asset of 323 hectares of accessible urban community woodland has been realised. With over €14m of GVA, positive impact on property values of €11m and €36m of wider economic benefit, developing the Northwich Woodlands has made a significant improvement to the visual image, aesthetics and public safety of the area. It is clearly loved by the residents with 30% visiting weekly, it is home to one of the most successful volunteer groups in the country with two hundred and fifty members and a place where partners work together to celebrate, protect and enhance the post-industrial salt landscape. Today, the woodlands are a popular oasis for the residents of Northwich and beyond providing 28 km of off-road walking, cycling and horse riding. The woodlands planted in the early years are now being thinned, creating opportunities to link to new programmes around health, woodfuel and recreation. The main challenge is now to realise the benefits that the urban forest that the regeneration of the brownfield land has enabled.

**Keywords:** brownfield community woodland regeneration urban

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## **Preserving an existing urban forest from overbuilding**

*Patrizia Binda*

*Associazione Parco Piazza d'Armi–le Giardiniere*

We focus on the importance of preserving an existing urban forest in Milan from the risk of overbuilding. In our cities, green and permeable areas are precious. There are semi-abandoned areas where in the last thirty to forty years, nature has regenerated, including the spontaneous growth of many and different varieties of trees. We would like to tell the story of Piazza d'Armi Milano, considered an exemplary case study and an area that is at risk of being sold by the state and built upon, removing one of Milan's main green resources and lungs of a city already struggling with air pollution problems. If the general territorial plan, PgT, states a very high edification index, as it is at the moment, this may seriously inhibit the preservation of such existing green resources. Piazza d'Armi was part of a military complex; until the 1980s, the open fields behind the barracks were used by soldiers learning how to drive tanks. After Italy eliminated its obligatory military service, the area fell into disuse and began to renaturalize. In the intervening decades, indigenous flora and fauna have reappeared and now the landscape has once again become Lombard lowland forests. There are also some marshy areas. We describe the ecosystem services that this wide area (35 ha.) provides for free to the citizenry and we provide an estimate of the monetary value of some ecosystem aspects, such as retaining rain water, carbon sequestration, pollination and so on. At present the study of removal PM10 and NO2 air pollutants by the existing trees in Piazza d'Armi is a research project by researchers of Politecnico di Milano, applying to European Life program for environment 2018.

# Management of the urban and peri-urban forest in the Aburra Valley Medellín Colombia

*María del Pilar Restrepo Mesa*  
*Metropolitan Área of Aburra Valley*

The Metropolitan Area of Aburra Valley is urban environmental authority in ten municipalities, which are Medellín, is the capital of Antioquia Department, with a population of more than 3.800.000 inhabitants, in a territory with strong urban-rural dynamics that affect strategic ecosystems and other areas of environmental importance, which reduce the provision of goods and services and the quality of life of the population. Are also, recorded deficit indicators of green public space (5.2 m<sup>2</sup> / *per capita*) and number of trees (0,5/ per 3 inhabitants), associated with a low increase of public green spaces and a weak appropriation by citizens. In addition, critical episodes of air quality due to climatic and geographic conditions and the exponential increase of the vehicles are logged. In order to address this problem, the entity in partnership with public and private institutions and citizens, has been implementing instruments of policy, plans, projects and actions associated with the consolidation of green infrastructure (52 urban ecological networks and 34 urban-rural networks), management and/or acquisition of properties with environmental quality for the generation of new green areas, community tree brigades for the preventive management of urban woodland, strengthening of the information system of urban tree, planting of one million new trees in the period 2016-2019 (683.000 to date), implementation of payment schemes for environmental services, divulgation of technical guidelines and the issuance of various administrative acts (accord Metropolitan of 2017 and resolutions of August 2018), through which a green background is created to generate new green public spaces, a model of ecological valuation of trees affected by constructive projects is adopted, the social appropriation of green spaces is promoted, among others.

**Keywords:** deficit urban green areas *per capita*, urban and peri-urban forest management, payment for environmental services in urban áreas, community tree brigades, urban ecological networks.

## The Present – *Changing Environment*

## Technological and agronomic aspects in BIV design: case studies

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The solutions of Building Integrated Vegetation (BIV) in urban areas are a way of responding - from an economic, ecological and social point of view - to the challenges related to the paradigms of resilience, adaptability and transformability of anthropized areas. The paper deals with an experience of technological transfer aimed at developing a new sustainable and performing modular Living Wall System (LWS). A multidisciplinary study was carried out by agronomists and architects, with the partnership of a small enterprise for material recycling, a nursery specialized in new technologies and finally a leading enterprise in advanced wall systems. The outcomes obtained in the multidisciplinary research project led to the founding of the Growing Green. Growing Green is a Politecnico di Torino's Spin-off working in cooperation with University of Turin. The development and production of eco-friendly LWSs, closely connected to R&D activities, can be assumed as the Growing Green core business. The Spin-off is therefore aimed to place on the construction market low environmental impact LWSs based on: simplified and standardized products; vegetated modular boxes manufactured with a limited number of materials, substructures and installations; a building system characterized by reversible connections. The paper deals with the presentation of case studies and discusses technological and agronomic aspects related to manufacturing (e.g. reduction of material intensity, industrialization of processes), on site assembling (e.g. quick-installing procedures, pre-vegetation, building integration) and maintenance stages (e.g. reduction of water needs and number of pruning per year, automatic control).

**Keywords:** Living Wall System, technological transfer, vegetated modular boxes, low environmental impact

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# Differing impact of climate change on tree decline in two urban parks in Milan

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Heat waves and extended droughts are strongly impacting urban greenery in Mediterranean countries. The extent of the damage caused by these phenomena depends on a number of factors, including the species of tree involved, the soil type, the origin of the tree population (natural or artificial), and the stand management. In the framework of a EU research project, the health state of broadleaf trees was investigated in two parks of Milan, the Boscoincittà Park and the North Park (located respectively in the south-west and north of Milan). Permanent plots were laid out in the two parks and all trees growing inside were labelled and inspected at regular intervals during three growing seasons. The following variables were assessed: crown thinning (with or without the withering of the leaves and branches); the capacity of tree crowns to recover from summer drought; rate of pathogen occurrence; and tree mortality. The disease picture in each park was very different. In the Boscoincittà park, which is rich in water, the practice of watering the trees to alleviate drought stress led to an epidemic spread of *Phytophthora*. These virulent pathogens, also known as water moulds, spread aggressively through the watered stands, infecting and killing hundreds of trees. By contrast, in the North Park, which is located in a former industrial area with much less water available, the prolonged summer droughts strongly impaired the tree physiology, causing leaf fall, with a reduction of the photosynthetic apparatus, and cessation of growth. When the droughts persisted for more than one year, most of the trees showed reduced vigour (probably because their starch reserves had become depleted to replenish the crown), leaf shedding, progressive death of twigs and branches, and tree death. Drought damage also increased tree susceptibility to a number of opportunistic pathogens, which aggressively colonised the suffering trees.

**Keywords:** abiotic stresses, drought, pathogens, crown transparency, tree dieback

## **Invasive forest pest develops faster and has higher survival in urban forests**

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The pine processionary moth (*Thaumetopoea pityocampa*; “PPM”) is a serious pest of pine trees throughout its native range in the Mediterranean Basin, and this range is expanding with climate change. PPM caterpillars are covered in urticating hairs that they can release when disturbed, causing allergic reactions in humans and other vertebrates. Despite its risk to humans, the PPM has primarily been studied in areas where human population density is low. However, cities contain ample host trees, and preliminary evidence suggests that caterpillars in cities may have higher survival during cold periods than caterpillars outside cities as a result of the urban heat island effect. Here, we report the results of studies based in Orléans, France, considering whether PPM colonies in cities have altered phenology and survival compared to PPM colonies outside urban areas. Differences in phenology between cities and forests have important implications for control and for reducing health risks to humans. In addition, the PPM is one of the best-studied examples of an organism shifting its range with climate change. Our results suggest that cities may be especially suitable for the PPM, and future models of the range expansion should account for this.

## Multipurpose trees for cities

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Urban forests widely improve urban landscapes and provide important services to people such as shade, better air and therapy. Whilst these are one of the most impressive changes in urban policies, agroforestry practice has reconverted rural fields into multifunctional spaces with great benefits on the landscape. It is certain that in time more interactions from trees in farms will be discovered and the landscapes will be renewed. This research states that both of these practices should be combined to answer needs in food security and provide a healthier urban environment. Through a landscape architectural approach, this article will assess how agroforestry could be part of the urban environment. How can agroforestry be shaped in the cities? Who does it involve? Can multipurpose trees improve the landscape? What are the purposes of agroforestry in a city? How can it revive open spaces and connect the inner city with the urban fringe? These questions will be answered through an assessment on agroforestry practices, urban forests and urban agriculture. Case studies will show how urban agroforestry has been planned in Tropical Climates and the benefits that have been generated. This will bring to a definition of urban agroforestry for Temperate Climates. Finally, this article will pursue with a feedback from an experience in Budapest where a test-plot is being planned in the frames of agroforestry and agro-ecology. The plot is in a residential alley nearby a school for visually impaired children. The goal is to turn its bare and sandy soils into a recreational green space with the participation of the community.

**Key words:** urban planning, agroforestry, public participation, renewal of landscapes

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## **Specific requirements for green areas, what type of trees should we use in cities with long winters - a specific case study in Korca city-the “small Paris” of Albania.**

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Green areas and trees are very important in creating a multiplicity habitat, both in natural and urban areas. Denominations of ecosystem, in general, is based on plant associations; regardless of the surfaces they occupy. Ecosystem goods (like food) and services (like waste assimilation) represent the benefits human populations derive/profit directly or indirectly, from ecosystem functions. In this sense, the greatest number of plant associations, increases more the functionality and quality ecosystems. Therefore, in urban areas, people began to increase green areas, together with roads and buildings. In Korca's case study, one the main cities of Albania, lies in the S-E of the country, 869m asl, has partially Mediterranean mountain climate and partly continental, cold winters and hot/dry summers. Annual average temperature reaches 10.6°C, many days are minus, January is cooler and August hotter, in November dropped 104 mm rain, and 720 mm was the annual average, with strong local winds. Korca is distinguished from straight streets, old city and streets are constructed by stone, with a rare cleanliness, is called the “small Paris” in Albania, can see an evident architecture and greenery with trees, shrubs and grass, within the city and suburbs, about 130531 inhabitants. In regions with long winters, like Korca, specific requirements for planting trees are considered physical aspects of the ecosystems such as soil, current and trends of climatic factors, short vegetation period, resistance low temperatures, frost, ice, rainfall/snow, winds. Based on the above, is necessary finding specific solutions for quality of urban ecosystems, providing greening in all seasons, combinations coniferous with broadleaves, fall leaves with evergreen, associated with trees, shrubs, grass, flowers. These issues treated in presentation, with final aim: well-being provided from greenery and trees in Ecosystem services sense as human health, air quality, ascetic aspects, landscape, quality of urban habitats improvements, increase and conservation biodiversity.

**Keywords:** Trees, urban area, Korca, winter, greenery

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## The role of the Urban Forest as an urban carbon sink

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Carbon (C) flows through ecosystems forming a cycle, not continuous, but it accumulates along them. There are processes that encourage the C accumulation on the atmosphere as a gas, which Carbon Dioxide (CO<sub>2</sub>) is the most abundant and well-known its relation to the greenhouse effect. Plants can act removing atmospheric CO<sub>2</sub> throughout autotrophic processes and adding organic matter which is stored as their own biomass [1]. As a result, the C keeps immobilized temporally within a process known as “carbon sequestration” [2], a measurable effect by quantifying the total amount of plants biomass [8]. Cities can act as a C source increasing its release to the atmosphere as CO<sub>2</sub>, from human activities related to combustion processes (traffic, industry and energy). Urban Forests (UF) are proposed as a nature-based solution in urban areas [3] due to its role as carbon sink, balancing part of this gas emissions. In order to achieve this effect, it is necessary to include specific criteria for taxon selection composition and typology of them [4] during designing stage of UF. Likewise, it will be essential to take into account to establish a management plan (pruning, spacing, etc.) Multicriteria species assessment is required, focused on C fixation capacity, in addition with other aspects [5], such as native vegetation, easy management, aesthetics, health, ecological coherence [6] and integrity criteria [7]. Impacts derived from UF implementation must be evaluated on medium-long term, since to C fixation capacity of the species is highly related to the maturity grade of the taxons [8]. Nowadays, UF are included in NBS categorization as a natural way to solve climate challenges in cities. URBAN GreenUP project [9] incorporates an UF as a Carbon Sink whose aim is to reduce the CO<sub>2</sub> concentration in cities through the CO<sub>2</sub> fixing capacity of their biomass.

**Keywords:** Urban Forest, CO<sub>2</sub>, Carbon sequestration, Carbon sink, Nature Based Solutions

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# The Growing Citadelle: Changing our Urban Cities One Farm at a Time

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Historically, citadelles (citadel) are the fortified central core of ancient civilizations, and is commonly interpreted as “small city”. Today, the concept of citadelles were altered by exponential increase of population in megacities, like the Philippines, causing competition in livable-sustainable spaces while compromising ecologically significant areas to provide housing and cater food demand. In the case of the Philippines, enormous accounts of riverbanks and important bird areas have been major targets for landfills to give birth to commercial establishments and residential areas in the last 10 years. In response to this action, groups of landscape architects once aimed to dilute such unacceptable constructions by sharing to common public insights on green housing solutions and state-of-the-art urban farming strategies in response to Philippines’ modern-day dystopia. Growing Citadelle, is a concept proposed to the general Filipino public to oppose one of the proposed high-end residential projects in the vicinity of one important bird sanctuaries along Estero de Trippa de Gallina, Paranaque City, Metro Manila, Philippines. This research study utilizes ecological gap phase succession strategies as the main backbone in reviving the current environmentally-degraded wetland areas in the said vicinity while building sustainable small cities within the Metro. As a product of immense study, the Growing Citadelle enabled the researchers to come up with 10 FoodBox designs- a mix of green housing designs equipped with specifically-designed urban farming techniques that permutate 100 possible design combinations that can grow either vertically or horizontally when combined. Furthermore, the researcher also proposed a state-of-the-art urban agricultural park and bird sanctuaries that are both made open to the public for social, economic, recreational and educational potential activities. The researcher envisioned the study as forefront prospective green solutions for battling multiple social issues faced by current struggling third world countries such as the Philippines and its neighboring countries.

**Keywords:** Urban Agriculture, Green Housing Design Solutions, Biodiversity, Ecological Services, Environmental Justice

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# **Removal of greenhouse gases and pollutants in periurban Mediterranean forests described by the Aggregated Interpretation of the Energy balance and water dynamics for Ecosystem services assessment (AIRTREE) model**

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The capacity to sequester greenhouse gases and pollutants from the atmosphere is one of the ecosystem services which plants provide to citizens in densely populated Mediterranean urban areas. However, the complex interactions between plants and the atmosphere in these regions are still poorly understood. In order to explore the capacity of plants to sequester carbon dioxide, ozone, and particles from the atmosphere, we elaborated a multi-layer and dynamic model composed of six different modules: 1. A hydrological component to predict soil water dynamics in response to precipitation, soil textural and hydraulic properties, and evapotranspiration. 2. a canopy model to determine leaf temperature and the radiative flux at different levels from above to the bottom of the canopy. 3. A deposition model based on calculation of different resistances to gas diffusion as a function of atmospheric resistance, leaf boundary layer resistance, and canopy resistances. 4. A photosynthesis model to estimate net photosynthesis and stomatal conductance. 5. A Volatile Organic Compounds (VOC) canopy emission module. 6. Carbon balance computation model based on species-specific allometric relationships to calculate above-ground and below-ground biomass. We validated the model with fluxes of energy, water and trace gases measured using the Eddy Covariance technique in a Mediterranean Holm oak forest located in Castelporziano presidential Estate, a peri-urban forest near the coast of Tyrrhenian sea, 20 km from Rome, Italy. Results show a good agreement between modelled and measured fluxes, highlighting potential application of the model to a broader range of forest ecosystems also thanks to a user-friendly and open access web-Gis interface.

**Keywords:** carbon sequestration, ozone sequestration, Volatile Organic Compounds, web-Gis model

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## **PM10 removal by urban green infrastructures in the valley of Po riverine (Northern Italy)**

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Po Valley cities in Northern Italy suffer for bad air quality standards because of the combined effects of valley morphology and human activities. Green infrastructures offer the opportunity to regulate air quality in urban environment by reducing air pollutant concentrations, thus providing a relevant ecosystem service. This study aims to assess the contribution of urban green to air quality improvement by the quantification of PM10 depositions in the city of Ferrara (Northern Italy). An urban park and an urban/peri-urban transect were sampled to estimate the spatial variation of PM10 deposition in different tree species. PM10 deposition on leaves was quantified by means of leaf washing and filtration. The investigation will describe the role of urban green infrastructures as ecosystem services providers. Moreover, it will shed light on the variation of ecological functions as a consequence of different plant stress conditions and pollutant levels. The outcomes of Ferrara case study will also provide suggestions concerning urban green management in Po valley cities.

**Keywords:** Air pollution, Ecosystem services, Urban green, Particulate matter

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# **FLOODS AND URBAN FOREST: mitigation strategies and methods in Prima Porta (Rome, Italy)**

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The study focuses on a neighborhood on the outskirts of Rome called Prima Porta, afflicted by recurrent floods, even if the drainage system has been recently improved. It is based on a site-level analysis and aims to reduce the volume of runoff in order to achieve an effective storm-water management, even in the case of extreme rainfall events. To this end, the research explores two hypothetical subsequent or overlapping operational steps. The first step consists in the introduction of Low Impact Development (LID) devices, like green roofs, draining parking areas and water tanks, which have immediate effects, reducing the urban outflow volume of about 8%. The second one has a more comprehensive ecological approach, reached by the progressive introduction of a local urban forest, which reduces the total runoff volume of about 9%. Besides that, the urban forest restores the natural hydrogeological cycle, thanks to the regulating capacities of the arboreal systems (evapotranspiration, interception, infiltration and evaporation), as well as improves both the aesthetic redevelopment and the quality of local life. The use of a hydrologic software, called Storm Water Management Model (SWMM), along the research makes possible the evaluation of which devices are more effective in terms of runoff management. The final result, after the analysis of the step-by-step evaluations, consists in defining the best intervention practice considering the quantity of water stored, construction time, aesthetics, and installation and maintenance costs. The overall strategy includes several operative and temporal steps: in particular, if both the public and private areas are included, the surface runoff decrease reaches 9.7% of the rainfall total volume.

**Keywords:** Urban drainage networks; Urban forest; Computer modeling; Landscape; SWMM.

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## Native and non-native monumental trees in Italian urban areas

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Monumental trees represent both historical heritage and scientific assets; they have important cultural and biodiversity values. These trees can be found in different landscape contexts ranging from remote mountain areas to cities. In Italy, an official list of monumental trees was recently produced and published under the Law no. 10 of 14 January 2013 and the Ministerial Decree 23 October 2014. Several criteria can be used to identify these trees: age and/or size, shape and growth habit, ecological value, floristic rarity, architectural structure, landscape quality, and historical, cultural and religious value. Our aim was to describe the community of monumental trees and the relative importance between native and non-native species within urban areas and urban-related cover types. We analysed the official list and included it in a geographic database to distinguish between, national and regional, native and non-native species by using recently published national species checklists. Among the total 2081 records of single or group of trees forming the list, we focused on those occurring within towns, cities and over urban-related land covers (e.g. villas, gardens). A high proportion of these species (>50%) are non-native to Italy or to the regions in which they are found and, among these, some are considered invasive (e.g. *Robinia pseudoacacia*). By using the geographic coordinates it was possible to analyse the urban and the environmental contexts in which these trees are growing. These trees are found both in private (e.g. historical villas, religious locations) and public (e.g. parks and roads) urban spaces. In general, these monumental trees represent an important feature in terms of biodiversity, well-being and cultural value of Italian urban settings. In addition, they can be considered as sentinel sites to monitor potential naturalisation processes of non-native species along a latitudinal range and can provide useful ecological information for tree management.

**Keywords:** monumental tree, cultural heritage, non-native tree, urban biodiversity

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## **The Nature Reserve Bosco della Fontana: an ancient woodland and biodiversity hot spot**

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The nature reserve Bosco della Fontana is an ancient woodland, which means that it had been covered by forests since at least 1600. This forest survived deforestation because it was the hunting ground of the princely family Gonzaga, that ruled Mantua from 1328 to 1708. Once the wooded area covered 1200 ha, but today only 200 ha of forest remain. This key habitat of the nature reserve is a biodiversity hotspot and here many species (fauna and flora) typical of Italian lowland forests have survived. For example more than 2600 species of invertebrates have been documented, including many protected species (e.g. *Lucanus cervus*, *Oxygastra curtisii*). Similarly, the flora of this forest is very rich (approximately 660 species documented), including many red list species and numerous indicator species for ancient woodlands, such as *Mercurialis perennis*. Today the reserve is part of Natura 2000, a network of nature protection areas in the European Union. The “National Centre for Forest Biodiversity "Bosco Fontana" Carabinieri” has carried out research on the entomofauna of this forest relict for more than 20 years and has documented its high biodiversity. Examples that will be presented are hoverflies (Syrphidae) and dragonflies (Odonata) together with research on protected species, such as *Lucanus cervus* and *Cerambyx cerdo*. Finally, based on the example of Bosco della Fontana, the general importance of ancient woodlands for biodiversity conservation will be outlined with indications for their management.

**Keywords:** ancient woodland, biodiversity, invertebrates, Natura 2000, Mantua

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## **Bioblitz - Environmental Education based in the perception and sensorial interpretation of Serralves biodiversity Park**

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The Environmental Education (EE) formal and non-formal synergy with educational and scientific strategy, knowledge promotion, valorising attitudes and behaviour, as the base important in shaping the individual. The project takes as reference "Sharing Nature" which addresses the biodiversity in a 7 days event where everyone shares and experiences nature. The proposed research aims to demonstrate the applicability of methodologies and strategies perception and sensorial interpretation in the context of dissemination and scientific literacy of students and teachers of basic education. The methodology will be based on learning activities, sensorial exploration and cognitive of biodiversity, reinforced by scientific knowledge and artistic expression. The aim is to articulate the interdisciplinary and cross-cutting with EA's scientific exploration, behavioural target audience records are cross- checking them and selecting case studies relevant to the outlined objectives. Looking for new expressions in the conceptual and scientific field described problem, the intention is to refine methodologies already experienced in this field of work and develop a new approach to the asked question. Trough these educational and scientific activities, are pointed out to new opportunities, teaching content and scientific methods in EA and consequences on the individuals training.

**Keywords:** Environmental education; biodiversity; perception, sensorial interpretation, literacy

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## Basidiomycetes common to standing urban trees

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Street trees and safety are side-by-side when it comes to managing urban GI. Basidiomycetes are known for causing wood decay, changing the mechanical structure of wood and increasing the risk of failure of trees. This study aimed at making an inventory of basidiomycetes detected during risk assessment inspections of urban trees, carried out in Portugal since 2015. The objective was to understand the existing fungal biodiversity and functional richness of the main communities encountered (most representative genus). When possible, fruit bodies were collected and morphologically identified; in some cases, molecular identification was also performed to confirm the taxa at the species level. In total 183 basidiomes were sampled, among which *Inonotus*, *Ganoderma* and *Phellinus* were the three most representative genus. The lowest functional richness (of two) belongs to the genus *Inonotus* despite being the one with more basidiomes seen throughout the study (24% of all observations in seven different hosts). The genus *Ganoderma* has a functional richness of three (21% of the basidiomes), with *G. australe* being the most common species. The highest functional richness (of six) belonged to the *Phellinus* genus (20% of the fruit bodies observed), with the following species identified: *P. igniarius*, *P. pini*, *P. pomaceus*, *P. punctatus*, *P. torulosus* and *P. tuberculosus*. Furthermore, the species *Abortiporus biennis*, *Perenniporia fraxinea* and *Rigidoporus ulmarius* were often found contrarily to what commonly used to be perceived. The last two species are commonly misidentified due to morphological similarities; same happens with *A. biennis* and *Meripilus giganteus*. The presence of fruit bodies of wood-rotting basidiomycetes is an indicator of advance wood decay in standing trees. The ability to reliably identify these fungi can be an important tool for field diagnosis and tree hazard assessment, besides being useful to support ecological studies in UF and UPF environments.

**Keywords:** wood-rot fungi; *Inonotus rickii*; diagnosis; diversity; tree risk assessment

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## Adequate Tool for Urban Tree Diversity Assessment?

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Urban trees are crucial components of sustainable cities as they provide significant ecosystem services to urban citizens. Ecosystem services are relying on the diversity of urban trees as diversity enhances the ability of urban trees to adapt to current and future pressures and threats. The first step towards management of urban tree diversity is to conduct a tree inventory. An assessment of urban tree species establishes a baseline for setting management objectives for urban tree diversity.

In this study, an urban tree assessment is conducted in the city of Helsinki. The aim is to describe the diversity of the present urban trees and urban forest structure. The primary objective of the urban tree policy of the city of Helsinki is “to secure the vitality of Helsinki’s urban trees, the values attached to them, and the ecosystem services provided by them”. Information about the current urban tree diversity, distribution, and structure of the urban forest are needed to achieve these goals. The knowledge gained can be used to support urban tree planning and management, so that the resilience of the local urban forests is increased. Also, the monetary value of the ecosystem services provided by urban forest can be estimated on the grounds of a proper inventory.

**Keywords:** urban tree, urban forest, diversity, resilience

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## **Can Forests Take The Heat? Managing pests and ecosystem services in urban landscapes.**

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Urban forests provide important benefits to urban residents and in mitigating climate change. However, US urban forests are shrinking due in large part to arthropod pests which are more abundant and damaging in urban than rural forests. Our hypothesis was that elevated temperatures and drought due to impervious surface cover drive arthropod pest abundance through several ecological mechanisms. We found that the urban heat island effect increases scale insect survival and that high temperatures create a phenological mismatch between scale insects and their parasitoids. This reduces biological control and increases scale reproduction. Finally, heat and drought stress combine to increase scale insect fecundity by 50 percent in sites with the most impervious surface cover. To counter these effects we developed impervious surface thresholds that planners and planters can use when designing sustainable urban landscapes.

## Tree species from two contrasting habitats for use at harsh urban environments respond differently to extreme drought

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The role of trees in city cooling has warranted much attention based on concerns over climate change and urban expansion. Simultaneously, there is an interest in introducing species from dry habitats to cope with the increasing risks of drought under climate change. The general understanding is that the evolutionary adaptation to respective resource supplies in species' habitats affects their environmental tolerance. The physical performances of six frequently planted species, originating from two contrasting habitats, were tested in a drought experiment. We (1) investigated if species from drier habitats are more drought tolerant than species that have evolved in Central European woodlands under a temperate climate regime and (2) discussed the effect of tolerance on the cooling potential of these trees. Native species from mesic habitats maintained only 48% of their controls sap flux and of these species, *Tilia cordata* had the worst performance with premature leaf senescence. Species from drier habitats had less reduction in sap flux (60%) but lower stem growth, possibly favouring (fine) root development into deeper soil layers, as observed when comparing linden species. Higher stem water exploitation and stronger regulation of water use at high evaporative demand were further reaction patterns that likely helped species from dry habitats maintain good physiological functions. Therefore, even under sustained drought, we expect them to have a higher cooling capacity. As a conclusion, they should be favoured for planting in extreme urban environments. Systematic screening and testing of promising species from target habitats is recommended to diversify the choice of species.

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## The Present – *Changing Benefits*

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It is estimated that about 20% of the European Union's population is exposed to continuous daytime outdoor noise above 65 dB (A), mainly due to road traffic. Over 40% of citizens are exposed to noise levels between 55 and 65 dB (A), a value that is considered as the attention threshold for which serious disturbances may occur. Among the ecosystem services provided by urban vegetation there is the reduction of noise pollution. Small hedges (about 2.5 m high) are widely spread in the urban vegetation and have the peculiarity of being easily planted close to the source of noise and pollution. This study investigates the sound pressure reduction due to small hedges of *Prunus laurocerasus* and *Laurus nobilis*. After the characterization of porosity of considered hedges, the total noise reduction and the effect of vegetation on sound spectra were investigated. The hedge widths ranged from 0.4 to 1.9 m. Four different experiments were carried out, including the use of two different sound sources and the measurement of sound at different distances both from the green barrier and from the sound source. During one experiment, the influence of different surface (grass and paved road) between the sound source and the receiver was also evaluated. The results indicate an average sound reduction of about 5.5 dB (max 15.8; min 0.5 dB). This effect is particularly relevant in the range of higher frequencies (between 2 and 20 KHz). In the paper these factors are studied and discussed, as well the role and potentiality of small hedges in the reduction of noise pollution. This study can contribute to plan and design hedges in the urban context.

**Keywords:** noise, ecological services, green barrier

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## Effect of noise pollution along vegetation strips in the city of Curitiba, Brazil

*Jefferson Dias de Oliveira\*, Daniela Biondi, Antonio Carlos Batista, Allan Rodrigo Nunho dos Reis, Bruna Bomm, Juliane Nesi and Eduarda Ximenes Dantas.*

*UFPR*

The study aimed to evaluate the effect of vehicle traffic noise along vegetation strips in Curitiba, Brazil. The study was carried out at Botanical Garden (transect A and B) and São Lourenço (transect-C) parks during summer and winter seasons. Using two decibel meter devices, simultaneous measurements were performed on each sampling site – one at the noise source along the avenue and the others in different distances (5, 10, 15 to 60m) from the noise source, with 3 treatments (types of vegetation) and 3 repetitions. Each transect was physically described by collecting vegetation info previously. Variance analysis (ANOVA) and Tukey Test with 5% of probability was performed in order to assess the variation of noise along the transects. The noise attenuation values were higher as further the noise source was, being significantly different. At the transect-A (lowest level of vegetation amount) the distances of 35, 45 and 55 m have displayed the best noise attenuation average with 10.8, 11.0, 10.9 dBeq, respectively. At the transect-B (intermediate level of vegetation amount) the best noise attenuation average was obtained by the distance of 45m. In case of the transect-C (highest level of vegetation amount) the best results were at 40 to 60m (40 – 13.9; 45 – 14.0; 50 – 14.2; 55 – 14.4 and 60 – 14.8 dBeq). The worse noise attenuation averages were presented at 5 and 10 m distant over all transects, with maximum value of 6.4 dBeq reduced. Noise attenuation average of transects A and B revealed different statistic results for summer and winter periods, as being respectively 8.5 and 7.6 dBeq at the transect-A and 8.4 and 9.1 dBeq at transect-B. There was no difference between seasons from the transect-C analysis. The vegetation present within the green areas provided a significant acoustic isolation, highlighting the importance of vegetation strips nearby heavy traffic roads.

**Keywords:** Noise attenuation, decibel meter, urban green areas

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## Internationalizing Urban Ecosystem Benefits through I-Tree Eco

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Urbanization around the world is increasing rapidly. As more people flock to cities, infrastructure becomes stressed, air and water quality deteriorate, and the overall well-being of urban dwellers can suffer. Urban green spaces are often the first casualties as cities build, bulldoze and expand to accommodate their burgeoning populations. So how can a city planner, elected representative or community group advocate for greener space? i-Tree ([www.itreetools.org](http://www.itreetools.org)), a suite of tools designed by the US Forest Service to quantify the environmental services and values trees provide, may provide an innovative solution. The core tool, I-Tree Eco is designed to use field data along with local air pollution and meteorological data to quantify forest structure, environmental effects, and value to communities. I-Tree Eco can provide hard data on everything from carbon sequestration to avoided runoff to species condition and biomass, and in doing so can create compelling narratives that can influence policy and engage the public. Because I-Tree Eco requires local environmental data, however, its use beyond the United States has been limited. Over the past several years, though, the tool has been developed in Canada, the UK and Australia. Now, in an effort to engage people where they live, the US Forest Service International Programs (USFS-IP) has collaborated with the Davey Institute to develop I-Tree Eco for Mexico and Colombia, and is exploring its expansion to the Philippines. This presentation will highlight case studies of how the tool has been used in diverse and engaging ways across the globe. Overall, innovative planning and engagement tools, such as I-Tree, can provide robust information to better inform urban development and policy. More importantly, they can be used as educational platforms to engage the public and improve well-being.

**Keywords:** environmental services, ecosystem benefits, urban planning, community engagement, policy

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# Carbon sequestration capability provided by different types of green areas in Rome

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Carbon dioxide (CO<sub>2</sub>) has been recognized as a major driver of climate change accounting for over 80% of all greenhouse gas emissions in the European Union. In particular, urban green areas represent a sink of CO<sub>2</sub> due to plants capacity to fix carbon via photosynthesis and store the carbon excess as biomass. However, the plant CO<sub>2</sub> sequestration capability occurs at different rates depending on plant species, the relative growth rate and the photosynthetic capability. Rome is among the largest European cities, with a surface area of 1285 Km<sup>2</sup>, where the green areas represent 35.3% of the total surface. In such context, the main objective of this research was to quantify the plant CO<sub>2</sub> sequestration capability (CS, Mg CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup>) by green areas of different size, location and vegetation types in Rome. In particular, four historical residences (Villa Pamphjli, 184 ha, Villa Ada Savoia, 160 ha, Villa Borghese, 74 ha, and Villa Torlonia, 14 ha), the Botanical Garden of Rome (12 ha) and the Campus of the Sapienza University of Rome (20.3 ha) were analyzed. The CS of the four historical residences were 780, 998, 664 and 756 Mg CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup> respectively, the Botanical Garden 809 Mg CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup>, and the Campus 43.4 Mg CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup>. The results highlight the importance of green areas in cities in order to mitigate the atmospheric CO<sub>2</sub> concentration increasing. Our data concerning CS capability by green areas might be incorporated in a geographic information system allowing the monitoring of CO<sub>2</sub> concentration variations over time, implement strategies to maximize the urban vegetation ecological function and the management practices to fully realize the benefits of the services that green areas can provide.

**Key words:** CO<sub>2</sub> sequestration, Ecosystem services, Urban parks

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# **Simulating shade tree impacts on building temperature quantifies the benefit of urban forests on avoided carbon emissions**

*Maggie DeMarco, Theodore Endreny\**

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Climate and land cover disruption has increased building cooling loads, but and carbon based cooling is problematic due to its production of greenhouse gases and prohibitive cost for some. This research presents a freeware computer tool, i-Tree Chill, which estimates how shade trees reduce shortwave radiation and skin temperature on buildings and thereby reduce the building cooling load. The tool represents tree canopy shape and dimensions with cylinder, cone, and sphere geometries, establishes tree location in Cartesian space relative to the building exterior, and projects the tree canopy shade on the building wall and roof for each hour of a calendar year, as a function of solar azimuth and solar zenith. The tool determines building area receiving direct shortwave radiation and shade extinguished shortwave radiation, and converts that to skin temperatures based on external building materials. The tool uses a three resistance and two capacitance heat transfer model to quantify the building cooling load based on parameters that include building physical properties, target indoor air temperature and internal mass. Building resistance and capacitance values are determined based on building materials and year of construction using time period building codes. By establishing shade trees as a cooling solution, i-Tree Chill reduces carbon-based energy demand and greenhouse gas emissions.

**Keywords:** solar heat gain, cooling loads, shade trees, resistance capacitance model, air conditioning

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## How to measure urban forest performances

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Urban forests generate several benefits like flood reduction, food security, air quality improvement, urban heat island effect attenuation and energy consumption reduction, contributing to climate change adaptation/mitigation and urban resilience. It is necessary to assess the multiple benefits generated from urban green systems to recognise their full impact and to define policies and measures suitable for conservation and enhancement. An urban ecosystem is a dynamic system. Therefore, regular monitoring through the use of measurable indicators is needed. A system of indicators based on the ecosystem services will be able to catch all benefits and co-benefits generated. This paper presents a conceptual framework based on the ecosystem services approach to develop a set of KPIs for the assessment of urban forests. Several initiatives to evaluate green systems performances are analysed, including comprehensive approaches (MAES Urban), European awards (European Green Capital Award, Green Leaf Award), ISO standards (ISO 37120 on smart and sustainable cities, ISO 37121 on resilient cities). Moreover the global framework provided by the SDGs and the Aichi biodiversity targets is considered. More than 1000 indicators are reviewed at this purpose. Based on such screening and through the involvement of several cities participating at H2020 project Urban GreenUP, a set of KPIs to evaluate impacts and co-benefits generated by green systems is built. The indicators have been classified based on: i) challenges that cities have to face, ii) ecosystem services provided and iii) the scale of impact. 153 KPIs have been selected. The proposed set of indicators allows to take into consideration several dimensions of environmental, economic and social nature and it can be customised in order to follow specific research and policy aims. This integrated framework may then be applied to develop a composite indicator-based assessment model to measure and monitor performances of urban green systems in cities.

**Keywords:** urban green system, performance evaluation, ecosystem services, KPIs, urban resilience

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# A Systemic Design application for resources management in urban green spaces

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Urban green spaces are often analyzed by the quantity of provided services, the kind of benefits they supply for the community and the human actions that modify the urban ecosystems. Moreover, urban green spaces and green infrastructures can produce important resources, even if these latter are not always considered during the preparation of management plans. To this extent, the Systemic Design can help to show the qualitative aspects of these resources and how they can be managed. Aim of this study is therefore to illustrate how a holistic approach like the Systemic Design can be applied to the management of urban green infrastructure, their ecosystem services and the raw materials and resources useful for the community. With an application to a real case, we will show how a Systemic Design approach is able to state resources' availability in a green urban area with the consequent identification of the area in which these resources can be employed. This identification is the essential prerequisite for the creation of a plan that stress the links among ecosystem services, resources and urban dwellers and the consequent best management practices, with particular emphasis on challenges related to climate changes and increasing urbanization. When necessary, Systemic Design can also provide viable indications to redesign a new context with different fluxes of materials and energy and can contribute to the creation of a set of new activities deeply connected with local green spaces. The final results can be identified in the creation of work tools for administrators and urban designers interested in the integrated management of green infrastructures and the suggestion of a new urban model, with stronger connections between society and territory, for more sustainable and resilient cities.

**Keywords:** Green Urban Spaces; Systemic Design; Ecosystem Services

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## **The innovative approach of Life Integrated Project Gestire 2020: technical facilitators for the involvement of local communities**

*Giuliana Cavalli\*, Marco Torretta, Bruna Comini*

*Regional Agency for Services in Agriculture and Forest – Lombardia Region*

The Lombardy region is especially rich in habitats; however, intense urbanization and fragmentation due to grey infrastructures critically endanger valley habitats. Forests, wetlands, trees, hedges are crucial elements of the regional landscape, contributing to biodiversity conservation against the urban sprawl. They are therefore protected by both the EU Natura 2000 Network and the Regional Ecological Network. Lombardy regional government is currently running the EU-funded, 8 years long Life Integrated Project Gestire 2020 aiming to improve management effectiveness of Natura 2000 sites and their linking GI. The Gestire 2020 innovative approach seeks the active involvement of local stakeholders (managing authorities, farms, associations, private citizens etc...) offering them free expert support by “technical facilitators”, professionals whose tasks involve: (a) selecting projects which may improve the GI; (b) provide specialist support to stakeholders; (c) collecting information on suitable available funding schemes (private/public); (d) participatory knowledge sharing of choices and best practices. Among the 16 technical facilitators total, 4 are specialists focusing on fundraising and stakeholders involvement, while 12 are locally active, drafting the actual projects towards the improvement of regional ecological connectivity. The role of technical facilitators is therefore pivotal in raising almost 83 mil € of complementary funding which are going to integrate those already awarded by the EU to the Gestire 2020 project.

**Keywords:** Local community, biodiversity, technical facilitators, green infrastructures

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# Long-term Management of Urban Green Areas: Possibility of Development in European Cities

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Green areas are essential elements of a city; they ensure an adequate quality of life for citizens through the provision of numerous ecosystem services. These areas must be managed appropriately, with a long-term approach aimed at achieving a healthy and livable urban ecosystem. For this reason, the management phase, seen as the union of the planning and maintenance phases, is necessary in order to guarantee the fruition of these areas over time. The maintenance phase is often held in poor consideration during the design phase, sometimes leading to non-achievement of the goals set in time. The goal to be achieved is to have a programmatic tool that takes into account all these aspects. For this purpose the American and European realities were analyzed and compared through a bibliographic research. This research highlights three main aspects: the different conception in the approach aimed at managing green areas; the number of American management plans compared to European ones; the low presence of the issue of ecosystem services in the European management plans. In the hope that many European realities will start to have a long-term management plan, we will list a series of key points to obtain this purpose.

**Key words:** ecosystem services; green infrastructure; urban forest; public spaces; urban ecosystem.

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## The Future – *Changing People*

## **Look More Closely, Think More Deeply, and Connect to the Urban Environment**

*Michelle Rabkin\**

*Chicago Academy of Sciences*

*Peggy Notebaert Nature Museum in partnership with the United States Forest Service - International Programs*

Imagine you are a third grader from Chicago. One cold winter day, you and your classmates step into an enormous, sun-filled greenhouse with live butterflies fluttering in and around the tropical plants. Your senses tune in to the sound of the water pools and the smell of the plants. This immersive experience is an everyday event at the Chicago Academy of Sciences / Peggy Notebaert Nature Museum--and much more than an entertaining field trip. Michelle Rabkin, Vice President of Education at the Nature Museum, will share about their Education Department's experience with building connections to nature and community. Known as "The Urban Gateway to Nature & Science," the Chicago Academy of Sciences / Peggy Notebaert Nature Museum sparks positive relationships between people and nature through partnerships, education, research, exhibits and public forums. Our core approach is to use hands-on experiences to foster urban connections to the region's nature and science. And the fun is not reserved for the kids alone: teachers also do better with experiential learning. The museum has helped communities to "discover" nature right where they live, and thereby fostered deeper commitment to environmental stewardship. Spanning over fifteen years, the partnership between the Nature Museum and the US Forest Service has emphasized engaging communities and educating teachers and students. Michelle will talk about the collaboration, which utilizes a place-based approach to reaching youth and educators in Chicago. They will explore how themes such as urban ecology and sustainability within cities can foster local connections to global conservation issues and raise awareness, create personal connections, and empower participants. By connecting the local community with local ecosystems and the museum's living and preserved collections, program participants gain knowledge and skills intertwined with an awareness of, excitement toward, and commitment to the natural world.

**Keywords:** urban ecology, environmental education, museum

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## Forest in the Slums: Utilizing Urban Forestry for Sustainable Community Development

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“Forest in the Slums: Utilizing Urban Forestry for Sustainable Community Development” is a study that explores on the formulation of an Urban Forestry Framework (UFF) for Barangay Damayang Lagi, Quezon City, Philippines. The site of interest is an informal-settler community with an estimated number of 1, 500 families dwelling on 2.1 hectares of land, and is bounded by highly urbanized areas and a river. Due to extreme density, and lack of open spaces and urban trees in the community—flooding, poor health and sanitation, and lack of alternative livelihood become difficulties that need proper and urgent action. Urban Forestry (UF) and Green Infrastructure (GI) provide diverse benefits to people and the environment. In line with this, a holistic Urban Forestry Framework that actively involves the households and other stakeholders, and integrates Landscape Architecture and Environmental Planning principles and standards shall be developed. The framework shall expound on a proposed redevelopment of the area that aims to improve the well-being and livelihood of the dwellers, and to foster connectivity and safety through the introduction of parks, greenways, and roof gardens. Furthermore, it shall emphasize on the importance long-term Urban Forestry management and inclusive decision-making and implementation for the future generation of communities in Barangay Damayang Lagi. The study shall be carried out using descriptive qualitative method through the investigation of existing standards and case studies, as well as interviews and discussions, to be able to provide recommendations that are most appropriate to the community and the site of interest.

**Keywords:** Environmental Planning, Urban Agriculture, Urban Design, Community Development, Sustainable Livelihood

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## The Future – *Changing Spaces and Places*

## **The Metro-Forest Project, Bangkok, Thailand. Reforestation for a better ecological and urban life.**

*Angsana Boonyobhas, Nantawan Sirisup, Tawatchai Kobkaikit\**  
*TK STUDIO, Landscape Architecture and Planning*

In 18 century, Thailand covered with 70% of forest areas but rapid expansion of agricultural and urban lands caused drastic reduction of forest to 30% in the following century. In 1989, Thai government has launched a forest protection policy and set up reforestation initiative; however, the reclamation rate was slow. Urbanization changed vegetation cover, released CO<sub>2</sub>, and created pollutions; such as increasing run off, waste disposal, water and air pollution, and city's temperature. Under initiatives set by the Petroleum Authority of Thailand (PTT) to increase forest areas, and in commemoration of the forest stewardship efforts by Her Royal Highness, Princess Maha Chakri Sirindhorn, an urban forest reflecting Bangkok's former landscape, demonstrating ecological regeneration, was planned, to cultivate environmental awareness and educate visitors about local forest ecology. The Metro-Forest Project is situated in a suburban sprawl eastern fringe of Bangkok which is a flood-prone zone. For less than 2 hectares of PTT's abandon plot; the site is surrounded with medium density residential and light commercial areas. This project consists of the rammed-earth exhibition center, sky walk and observation tower, and forest as outdoor exhibition. It offers a forest like urban park within a very small area that later received LEED Platinum NC. By applying Dr. Akira Miyawaki's reforestation technique of using high quality soil mixed to create forest berms which are excellent conditions for plant growth, and planted with vigorous saplings of approximately 60,000 trees of 279 unique species. The berms were also function as sponges for absorbing water, while buffering outside ambient as well. The Miyawaki's technique was statistically proven to be very successful, and discovered that the planted saplings grow three times higher in the first year and double in the following years. This natural wilderness provided educational and fun experience, hopefully, could inspire urbanites to create forest in their own backyard.

**Keywords:** The Metro Forest Project, Thailand, Urban forest, Eco-forest Reforestation Technique, Akira Miyawaki

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# The sustainability of urban forestry projects: a model of multi-criteria economic analysis

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The presence/spread of natural elements (urban forests) within the consolidated urban fabric can represent a strategic resource for cities' sustainable development in eco-systemic logic. The interventions execution aimed at implementing integrated urban forestry projects, especially in territorial areas characterized by insufficient levels of collective services, limited recreational areas and high air pollution, allows both to growing the environmental quality level by improving the microclimate and conserving biodiversity, both to support the socio-economic development of these city parts through eco-system services for population. Although the multiple effects generated by actions based on eco-systemic logics are now recognized – “Eco-systemic Integrated Projects” (EIP) – within urban policies this type of integrated intervention is still little used as a possible solution for the cities' smart growth. This is due to the interest in preferring actions with immediate financial effects, and due to the difficulty in carrying out evaluations on EIP not only concerning specific aspects (of an environmental, social, economic nature), but taking into account in an integrated manner the multidimensional and multi-criteria characteristics that define projects of this nature according to an eco-systemic logic. The aim of the present work is to define a set of criteria and indicators, value components not only referring to environmental, but also financial, social and cultural aspects, with which the EIP projects can be evaluated with an integrated way. These indicators are derived by relating the features (Targets) of the urban context of reference with the eco-system service type offered (Key Issue). These can be used in the application of different evaluation tools to support the decision-making process of both public and private subjects, that are involved in this intervention type, according to the different evaluation questions to be solved regarding, for example, the interventions' economic value and the benefits distribution between the public and private sectors.

**Keywords:** Urban Forests Planning; Sustainable Development; Economic Evaluation; Multi-Criteria Decision Analysis Tools.

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## Breathing Through Green Cells

*Cristina Greco\*, Marta Mitsch*

Our idea of an Urban Forest aims to fight actively against climatic change within our cities, to rethink how we live the city and strives to provide for a higher quality of life. Our goals are twofold. The first integrates into our cities a system of living green cells through architectural and urban design to facilitate the improvement of microclimatic conditions, which counterattack the phenomenon of heat islands and air pollution. The second naturally improves upon energy performance and decreases the cost of operation while ensuring comfort and wellbeing. Our research focuses on the development of a model based on simple living green cells and the implementation of BIM technology to facilitate the parameterisation of all information required to plan, execute, and manage these interventions over time. Our living cell is a simple cost-effective microenvironment that reduces the annual operating budget for a typical stewardship at a parameterised rate per tree while promoting nature and wellness, which engages both occupant and spectator alike when creatively applied to new construction or renovation. The base module is a self-contained prefabricated tank with an integrated water supply and disposal system. BIM technology facilitates the selection of the type of vegetation in accordance to orientation, resistance to pollution, aesthetic requirements and seasonal colours. It also provides information on physical dimension, weight, water consumption and other operational and design information that permits the informed planning of Urban Forests. The living cell provides aesthetically pleasing protective screen that mediates daylight and filters pollutants to re-establish a beneficial equilibrium. From a design perspective, the possibility to filter and control views to and from public spaces creating intimacy and healthier environments that foster social cohesion. The application of BIM technology facilitates the improvement of our urban environments.

**Keywords:** living green cells BIM design

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# Growing the Urban Forest Today for the City of Tomorrow: The Greening of Urban Communities

*Naomi Zürcher\**  
*Arbor Aegis*

The ever expanding urban footprint and its impact on the environment, near and far, emphasizes the need to rethink how we plan and manage our growing urban centers. While current greening strategies tend to be linear in design and construction – the "green ways that guide us to verdant edges" approach - our global situation requires us to think green in an "everywhere" sense, encouraging greening within every neighborhood from its own unique cultural perspective. Citizens would be able to follow a meandering Green Ribbon - a Web of greened urban life - that connects their neighborhood street with all other neighborhood streets via a web-like construct of street trees, greened vacant lots, plazas, parks and gardens. This "streets as parks" approach can thus collectively provide a culturally diverse green experience throughout a city. Green Web strategies have been implemented in various American and European cities from Public Easement Gardening in Ann Arbor Michigan, using varied size public spaces to encourage neighborhood beautification to Grünes Netz Hamburg Land Use Program, linking park facilities, sports grounds and cemeteries through broad or narrow green belts. Berlin's comprehensive undertaking, Biotope / Green Area Factor (BAF), exemplifies a "bottom up" decentralized strategy for green planning. According to the BAF program "for the protection of the landscape and of species, an important goal of urban development in Berlin is the reduction of the environmental impact in the city center. Improving the ecosystem's functionality and promoting the development of biotopes, while maintaining the current land use, are central to this endeavor." This Practitioner presentation, citing an array of creative schema, offers strategies for planning, implementing and managing an Urban Forest Green Web that abandons the linear approach and embraces the green needs of all residents, regardless of neighborhood location, cultural orientation or economic situation.

**Keywords:** Urban Forest, green web

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## Trento Smart Mountain Project

*Luca Marcheselli\**

*Climate Kic - Mach Foundation*

The present study is aimed to offer feasible and effective ideas for the valorization of the urban marginal areas of Trento, providing for, natural based, smart solutions, capable, as well, to mitigate and adapt the city to the effect of climate change. The smart solutions proposed represent a mix of already available technologies, most of which nation based, ready to be used by the city planners and policy makers. Key role is played by new green infrastructures, tailored on the four different waterways crossing the city center. Aim of the study is the combination of nature, culture, art and agriculture, bringing within the city what best the surrounding territory can offer. The smartest solutions should use the suburban and urban marginal areas to bring benefits, in term of climate mitigation, to the old town and the other critical areas and, at the same time, drawing attention and people with new cultural and social proposals.

**Keywords:** Climate-Kic Blue Green Infrastructures Mitigation

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## **We have a dream: bees in the ideal city of the future**

*Claudio Porrini\*, Laura Bortolotti, Francesco Cecere*

*University of Bologna*

*Council for Agricultural Research and Economics Agriculture and Environment Research Centre*

*Mantuan Beekeepers Association*

The fifteenth-century myth of the ideal city sought to combine functional needs and aesthetic sensibility. Following the massive urbanization of the last centuries, a new need has emerged: the presence of nature around our homes. A hypothetical ideal city today has to contemplate large natural spaces that, together with balconies, terraces, gardens and also traffic island with flower-beds, create ecological corridors with scalar flowering plants that are not treated with pesticides or mown during flowering. A place where bees can find natural shelters and artificial nests positioned all around the city; where the spontaneous flowers pollinated by the bees can bring beauty to the grayest areas, and where urban vegetable gardens become more productive thanks to the free pollination service carried out by the bees. A city that respects the fundamental role of wild and managed bees in the protection of biodiversity and food safety, and that promotes teaching and supports initiatives in their favor with concrete actions, such as the creation of didactic apiaries and bee-friendly gardens, with an additional artistic and educational value, available to schools and citizens.

**Keywords:** pollination, biodiversity, food, safety, beauty

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## **I AM A TREE - From Funeral Architecture to Landscape Architecture: A Project for the Third Millennium Cemetery**

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*A3Paesaggio Design Studio*

If we are each reborn as a tree after death, we will leave behind urban forests instead of cemeteries. I AM A TREE is a universal project that concerns every large city where the lack of space, the air quality, the health of citizens, together with the exponential spread of cremation, force a rethinking of traditional spaces creating a new architectural and landscape approach. It is an opportunity to reclaim wasteland and implement biodiversity in strongly anthropic systems through the design of new green spaces dedicated to the dead but planned for the living. I AM A TREE is therefore a city park, open to everyday use where trees mark the burial sites of ecological and biodegradable urns containing the ashes of our deceased. It is a vital space conceived for citizens who are called to protect and respect it, where multiple religions can be represented and thereby can live together with the respect and the common memory of those who are no longer among us. The landscaping and planting of each I AM A TREE memorial park is unique, developed with specific reference to local conditions and the requirements of the site. Climate, soil and geography determine the selection of plants and botanical species. The safeguard of biodiversity is one of the main goals of the project, which plans to introduce` ancient varieties of endangered tree species, especially fruit trees, in order to save and preserve not only the vegetal genetic heritage but also the traditional knowledge and the rural culture, without which a sustainable future could not exist. I AM A TREE is a sustainable urban project envisaged for air quality improvement and water runoff control that reduces the occupation of ground space, counteracts religious and ethnic differences and teaches a respect of nature as part of the common good.

**Keywords:** cemeteries, landscape architecture, urban regeneration, parks, biodiversity

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## The Hidden forest: Drawing Integrated Subsurface - Surface design

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The question of design and maintenance of healthy ecosystems in urban areas is crucial in order to support and generate a variety of services related to the notion of natural capital. Ideas related to 'renaturing', 'green infrastructures' and 'urban forests' are among the strategies through which cities around the world aims at re-deploying nature and deliver values in different ways. This paper introduces a series of spatial and temporal design strategies in order to deploy and sustain durable nature structures (ecosystems) starting from the space in which it grows; the subsurface. Taking the case of Rotterdam Bloemhof as a case study (as part of an interdisciplinary research by design project at the Delft University of Technology) for the testing and implementation of integrated infrastructure and environment design strategies. Here, the integration of bio-geo-subsurface and hydraulic engineering with the agency of soil coupled with urban – landscape design, become the main device in order to re-build healthy ecosystems aimed at dynamic co-existence of the natural and artificial domain. Furthermore, the paper reflects on a series of temporal strategies related to novel maintenance regimes of urban forestry by showing the potential synchronization of micro-economies and urban functions along with long term environmental performances related to water, nitrogen and carbon cycles. The agency of visualisation aims at showing the reciprocities in space between key environmental performances such as water retention, soil organic compounds, decomposition rates, oxidation rate and load reduction of nitrogen together with civil – hydraulic sectional strategies and subsurface programming. The focus is on rendering visible, through subsurface-surface design and the integration of the temporal dimension, the complexity and potentiality of urban reforestation as strategies of urbanisation.

**Keywords:** Integrated design, Subsurface engineering, Ecosystem Services, Landscape Laboratories

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# The Role of Citizen Science in Interpreting Biodiversity Related Landscape Services in Wild Urban Woodlands

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Decision-makers and governmental organizations are increasing the use of citizen volunteers to enhance the capacity to monitor species occurrence and distribution around the world, and to investigate major aspects of global change impacts on biodiversity. For citizens the motivation is to contribute to “real” science, public information and conservation. For scientists, citizen science offers. During the 4-days global citizen science’s event, City Nature Challenge 2018 ([www.citynaturechallenge.org](http://www.citynaturechallenge.org)), hundreds of citizens living or visiting Rome and Padua (Italy), have collected more than 1000 validated observations on urban biodiversity. These data, throughout the portal iNaturalist, feed the GBIF ([www.gbif.org](http://www.gbif.org)) contributing to increase freely available biodiversity data. We used data collected during the event to get evidence on the biological diversity (e.g. presence of alien/rare species) on target wild woodlands randomly distributed across both cities. Moreover, the City Nature Challenge’s observations can be used to obtain the number of visits in these urban “voids” by people. We indeed consider the visiting rate of these non-conventional urban green areas as an indirect measure of their accessibility and appreciation. Finally, we may also use these data to investigate ecological connectivity among these green ‘islands’ at the urban scale. Such experiences confirm that citizen science can play a key-role in supporting novel planning and management solutions for resilient cities, as the valorisation of transient woods in the naturing processes of cities is

**Keywords:** citizen science, urban planning, urban forest, biodiversity, volunteer monitoring.

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## Sustainable requisites for the compact urban landscape: Garden cities

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Modern compact cities have features that can contribute to practical urban design, supporting sustainability and important ecosystem services. Compact cities have an overall lower percentage of urban green spaces (UGS) that lack ecosystem services. On a daily basis, people need to be in contact with the natural-environment; UGS can supply this need. For urban inhabitants, UGS is often the only source of nature-based interaction readily available within any reasonable distance; hence, the question of how much greenery a person needs is very relevant. We discussed the quality and accessibility of UGS, attitudes toward UGS and how landscape architects and urban planners can incorporate greenery via the delivery system of ecosystem services to inhabitants for more resilient compact cities. We further highlight how much greenery is needed by interconnecting concepts within a compact cities garden approach.

**Keywords:** urban green spaces, garden cities, ecosystem services, biophilic urbanism, building-integrated vegetation

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## Developing a Parametric Urban Forest Tool

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Green roofs and plant façades are today's new frontier in the relationship between nature and architecture. The technique has given architecture operational concreteness, offering unexpected possibilities for people's primary desire to live in and with nature. Intended thus, the plant-related element is no longer proposed just as a theatre set; rather, it becomes a component of the project just like any industrialized material. In this way, vegetation adds to the quality of the overall housing system, adding a sign of increased sharing to the principles of sustainability required by environmental challenges. The aim of this work is to present an optimization analysis to determine some important parameters, such density, green typologies, vertical or horizontal direction, etc, to define the thermal behaviour of green devices and to proposed an optimal system strategy that not only improves the outdoor thermal comfort, but also improves the urban microclimate, reducing the cooling load of the buildings. The outdoor thermal comfort, in this research represented by Predicted Mean Vote (PMV) and Universal Thermal Climate Index (UTCI), is an important parameter to measure the quality of life in the city. Mainly, CFD tools such as ENVI-met and others (numerical, python language) like Grasshopper (that uses Energy Plus for its simulations) are used. Small interventions in specific sites of the urban city can bring about a considerable improvement in the quality of life of the citizens, outdoor comfort and cooling load reduction. By implementing an optimized strategy that combines green shading, vegetation and cool materials, the city can reach its goals to-ward the city sustainability plan.

The results show better outdoor and also indoor temperatures, with cooler environments in summer compared to the standard design solutions. The results are discussed and recommendations for simulating green devices are made.

**Keywords:** Parametric optimization, outdoor thermal comfort, Urban Green strategy

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## **Sustainable Urban Territorial Observatory: Three Cities Versus Three City Roles in Lima Peru**

*Siljha Chincaro\**

*Observatorio Urbano Territorial Sostenible*

Three Cities, three city roles in Lima, a capital with almost 10 million inhabitants in an Urban territory of "cities" that, from the Sustainable Urban Territorial Observatory, is observed and has a multidisciplinary and transdisciplinary observation methodology developed, from a humanization point of view, that departs from the quantitative to the qualitative starting from "common points", that show the connectivity and interconnectedness from an interlaced, dynamic Urban Territory, whose dependence and interdependence relationships, not only generate enormous urban surpluses on different scales and dimensions, but also share well-being, experiences, and an identity, but that are not "seen" in urban quantitative studies; a defined "territory", fragmented in political divisions (districts) that today are "autonomous urban cities" that seek to solve their dilemmas within their limits inside a megapolis. This fragmented vision does not see an integrated, Intelligent Territory, not only because of the continuous urban structure, but also because of the daily flows of living in a city that day by day shares, exchanges, complements itself, and that together, are key pieces to face an internationalization that has been growing at a geometric rate, therefore the district scale is reduced not only in the political boundary, but also in the understanding of an integrated Intelligent Global Urban Territory, international and sustainable, with strengths in integration (urban fabric, integrated communities, urban green areas, natural and urban landscape), a connectivity and interconnectedness, that is visualized in the Sustainable Urban Territorial Observatory, without it having to renounce the relations of the neighborhood, the district, and the metropolitan and global city. Citizen participation has been empowered in public spaces, parks, streets, and in small urban forests that have been connecting with each other, but at the same time shows the possibilities of a continuous spatial integration through active ecological corridors, diversified in an "artificial urban landscape" within a desert city, therefore a "green space" that costs, is valued, shared, and lived in, is diversified into unbundled spaces in different experiences and supplies, in part, the lack of green and public space from the rest of the population. How to deal with the transfer of diversified urban capital gains in Miraflores, San Isidro, and San Borja with the roles of global cities, the first touristic, gastronomic, leisure, of high residency with a strong identity, with an urban, natural and artificial landscape that connects land and sea? and San Isidro, a financial center that seeks a transfer of the green private space to the accessible public? San Borja, with a high residential urban green space crossed by several metropolitan flows of national, international, and inter-district scale, to maintain a residential neighborhood? A fourth city emerges, whose role is as a service provider to the three cities, Surquillo, located in the intersection of these cities but considered an urban gap in the planning of the cities, but with a high connectivity and interconnectivity in urban territory, that the other three cities do not possess? These unseen potentialities are the engine of an integrated Sustainable Urban Territory, strong in its interrelations; it is time for these strengths to unite in order to make way to a competitiveness as an urban territory towards a globalization that is already present but requires a change in focus and a redefinition of limits, based on flows smoothing the borders of the political boundaries to connect and live in a city through life networks, green networks, public space networks, citizen participation networks, ecological well-being corridors, humanization networks, without cracks, without urban gaps, and with living and integrated urban edges.

**Keywords:** Sustainable Urban Territorial Observatory, Urban Forest, Urban Territory, Sustainable City, Ecological Corridors.

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## The Future – *Changing Environment*

## **New Law Of The Tree In Santa Fe Province, Argentina.**

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The Government of Santa Fe Province present the project for a new "law of the tree". Its purpose is to establish a state policy on environmental matters, through the promotion and conservation of trees throughout the provincial territory, with a view to generating a healthy, balanced and suitable environment for human development. We are convinced that trees and their environmental services are strategic to defend the right of the population to live in a healthy environment, respecting the rights of nature and this public policy will rank them. The new law refers to the entire public tree, setting prohibitions and criteria for various situations of extraction of specimens, minimum requirements for implantation and conservation. It establishes tools for the cities, such as the Comprehensive Tree Management Plan. Other key axes are: the promotion of biological corridors in roads and routes is foreseen, the distinction of trees that must be protected because they have a patrimonial value in the community, the implementation of a Provincial Forestry Census is instituted, for updated and participatory knowledge of the forestry state of the province. Taking into account that the application of this norm, will bring with it a greater demand of species, a more active policy is foreseen with the public and private nurseries, through the creation of the "Provincial Nursery Network", to guarantee the institutionalized offer the needs and the strengthening of self-supply, promoting a broad agenda in the matter with all the stakeholders, enabling an adequate planning in order to achieve an effective afforestation. As an innovation in the country, the new law established that public buildings also have a minimum of protection, as well as rural properties belonging to the Provincial State, where double the percentage of fiscal protection for private property is required. In this way the Provincial State assumes a greater commitment to the objectives of the law.

**Keywords:** new law - tree - public forests

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## **Forest management strategies for the peri-urban forests: the stakeholders' point of view**

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The project LIFE14-CCM-IT-905-FoResMit has as objective to identify and apply innovative forest management strategies for the degraded peri-urban forests. The forest management strategies were identified through a participatory process in the pilot area of Monte Morello peri-urban forest (Tuscany region). In the first step of the participatory process, the main stakeholders of the Monte Morello peri-urban forest have been identified in order to involve them in the information activities - knowledge of the project (second step). The stakeholders were selected during two brainstorming sessions (April-May 2017) using two main criteria: group of membership and types of resources able to mobilize. In total, 32 stakeholders (10 public administrations, 5 environmental NGOs, 4 forest-wood chain actors, 10 tourism sector actors and 3 universities and research institutes) who were given a qualitative interview. The main topics developed during the interview were: "Professional - political career"; "Forest priorities of the public authority"; "Monte Morello: Initiatives and activities for the forest"; "Decision-making process between Monte Morello forest and public authority"; "Sensitization and promotion activities"; "Personal suggestions". Making a synthesis, and beyond the specifications that have emerged for each group, the richest dimension of suggestions and meaning have been "Sensitization and promotion activities" and "Personal suggestions". With regard to the last topic, particular points have emerged regarding possible scenarios for the forest of the future referring to the new economic and fiscal instruments aimed at enhancing their functions. In fact, specific strategies have been emphasized by stakeholders such as the PES (Payment for Ecosystem Services) and the voluntary carbon credit market. They have also been investigated the possibilities of an accord on territorial agreements in the sector, the theme of forest associations in order to overcome the problem of non-management of private forests, and the possibility of favoring public-private integration for the management of forest resource.

**Key words:** public participation, stakeholders' involvement, qualitative interview, voluntary carbon credit market, payment for ecosystem services (PES).

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## **FitoDetective: mobile application to support pest surveillance**

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The Lombardy Plant Protection Service believes it important to involve residents and professionals in a system of prevention and early detection. A mobile application for smartphones and tablets has therefore been devised. The App's name is FitoDetective and its objectives are as follows:

- provide sector operators, amateur biologists and entomologists with a tool that either confirms or excludes, simply and quickly, the presence of the most important alien plant pests;
- signal via geolocation the suspected presence of the harmful alien organisms for which a specific surveillance plan is underway;
- receive information about pests that endanger biodiversity and food security the world over.

The alien pests chosen for the first version of the App are:

1. *Anoplophora chinensis* and *Anoplophora glabripennis*
2. *Aromia bungii*
3. *Popillia japonica*
4. *Agrilus planipennis*
5. *Rhynchophorus ferrugineus*
6. *Erwinia amylovora*
7. *Pomacea* spp.
8. *Xylella fastidiosa*
9. *Halyomorpha halys*.

For each organism, users can consult an informative summary and view images, videos and distribution maps. In special situations, users are invited to participate in territorial surveillance by filling out and sending a simple text message and attaching one or more photographs of pest or indicators of pest presence. The application allows the user to send reports only from places where the presence of the pest has not yet been ascertained since for each organism the geolocation system either blocks or consents this function. All sightings received will be verified by the phytosanitary inspectors. Alerts will always be blocked for pest already spread throughout Lombardy or for pest whose symptoms can be easily confused with those due to other biotic and abiotic causes. The reporting system covers only Lombardy but all users, even those located outside the Lombardy region, will use the application to access information on pests and receive world news.

**Keywords:** alien pest, early detection, surveillance

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# **Saving Rio de Janeiro City Endangered Trees in Municipal Protection Areas**

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Rio de Janeiro City has a large number of endangered tree species, most in fragmented remnants inside small-sized municipal protected areas. So far there has been no comprehensive analysis of the occurrence of endangered tree species in these areas. This work aims to identify endangered tree species that occur in municipal protected areas, such as natural parks and natural monuments. Through the consolidation of existing lists of endangered plant species, we created a new endangered trees list with a hundred and seventy five species. Their occurrence is being checked in Brazilian main herbaria, such as Rio de Janeiro Botanical Garden and National Museum, and plant species databases such as speciesLink and REFLORA. We are also doing interviews with botanists, seed collectors, protected areas managers and environmentalists who know these trees populations occurrence in Rio de Janeiro City, to obtain specific information about places they still occur. Based on these data is being possible identify mistakes in the occurrence of these species, such as species only collected from cultivated specimens, or very old herborized material associated with Rio de Janeiro state and that was formerly wrongly assigned as being collected in Rio de Janeiro City. This information is supporting field surveys for specimens and populations of these trees in municipal protected areas, where some are used as matrices for forest seedlings to city nurseries, evaluating the conservation status of these populations and forest formations, main threats, and proposing emergency measures to in situ and ex situ conservation. These information was consolidated in a Spatial Database, using GIS, with the purpose of helping the management of these areas by park managers to guarantee the preservation of these trees. We are also preparing a citizen science model collaborative search of trees that were not collected in herbaria for more than five decades.

**Keywords:** endangered trees, flora conservation

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## Response of Common Urban Ornamentals to Infection by the Quarantine Pathogen *Phytophthora Ramorum*

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Plant nurseries in the Pistoia district are largely geared to producing ornamental species for planting in urban green spaces. This flourishing nursery activity is now under severe threat from *Phytophthora ramorum*, a virulent quarantine pathogen. The uncontrolled spread of this pathogen, which has recently been reported from the area, could jeopardize the market share that this district now enjoys in such plants, since buyers may be scared off and purchase their plant material from nurseries located elsewhere, in areas free from the disease. It is therefore a matter of the highest priority to identify the ornamental species most susceptible to *P. ramorum*, and also those particular plant species that become infected but that do not show any symptoms; these last species can in fact act as carrier hosts, spreading the pathogen epidemically to still uncontaminated green areas. Leaves of 16 ornamentals most commonly planted in urban green infrastructures of the Mediterranean area were collected, inoculated in the laboratory, and the extent of infection determined according to a standardised protocol. Results obtained confirmed the virulence of *P. ramorum* on *Viburnum tinus*, *Rhododendron* spp. and *Camellia japonica*. The pathogen was also highly aggressive on *Trachelospermum jasminoides* and *Ilex aquifolium*, this last being the most susceptible of all the species tested. *Loropetalum chinense*, *Prunus laurocerasus*, *Osmanthus* spp., *Syringa vulgaris* and *Arbutus unedo* were mildly susceptible. *Laurus nobilis*, *Magnolia stellata*, *Nerium oleander* and *Photinia fraseri* were not very susceptible. These results may be useful not only from an epidemiological point of view, but may also assist in choosing the most suitable species for planting in urban and peri-urban green spaces, especially in high-risk areas where the disease has already been reported.

**Keywords:** plant susceptibility, pathogen virulence, host selection, urban plantation

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## The Future – *Changing Benefits*

# Urban Trees' Timber: an Unknown Resource

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**Urban wood:** Public and private trees, shrubs, hedges to fulfill security and health standards, should be pruned and cyclically renewed, producing urban wood.

**What happens now:** Great part of that material goes into landfills, some is chipped, then composted, used for particles wood or burned for energy. Big trunks and branches are often just left to decay.

**What could happen:** Now days, with simple technologies trunk and large branches may be cut in boards even “in situ” where the tree has been removed.

- Boards could be used to produce outdoor or indoor furniture, as well as art and design works or common use objects.
- Smaller branches could be made in pieces for didactic and therapeutic activities.
- Leaves, small branches and sawing could be composted or used for energy.

**Why the process could be convenient:**

- a. A huge quantity of urban wood is available and may become urban timber;
- b. Urban timber may have symbolic values: Rome, Central Park, Tivoli Park timber...;
- c. Urban forests and their wood may become relevant CO<sub>2</sub> sinks.
- d. Modern arboriculture is producing better urban trees;
- e. New tools are available to produce urban trees' timber.
- f. Timber transformation may be multifunctional.

**Positive effects:**

**a) Environmental effects:**

- Carbon sink: wood is the carbon that trees assimilated. Preserving wood, as art works or furniture, implies carbon preservation. Its quantity may be defined.
- Sustainable energy production.
- Revenue production, then more resources for urban forests' management and plantations.

**b) Economic effects:**

- More jobs in local industries of trees, wood, design, art, therapies....

**c) Social and cultural effects, preservation of craft abilities.**

**Needs:**

- Demonstration and promotion;
- Pilot projects;
- Research;

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# Urban Forest Digital Cadastre

*Nicola Noe\**

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Based on open-source 2.0 web, the project aims to share the data collected on trees, shrubs and lawns as open data, i.e. for the city of Abbiategrasso <http://www.urbanplan.it/amaga/#>. The Urban Forest Digital Cadastre measures the quantity of urban botanical heritage and provides an estimate of the ecosystem services by Leaf Area Index.

**Keywords:** ecosystem services; urban botanical heritage; Leaf Area Index

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# Win-win public-private partnership for financing sustainable poplar plantations and biodiversity conservation in the Region of Lombardy

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Natural protected areas and the Regional Ecological Network are the main examples of Green Infrastructure that exist in the Region of Lombardy. Supporting the maintenance of these areas is a major challenge, especially in times of constraints in public spending. The paper presents a Payment for Biodiversity Conservation Scheme (ECOPAY Connect) that brings together park authorities, the timber industry, and the poplar tree farms under the common framework of FSC® (Forest Stewardship Council) certification. The scheme is carried out in an area under intensive poplar-plantation management in Southern Lombardy, where natural protection is carried out by the Oglio Sud Regional Park. In this context, on a local farm, "Rosa Anna and Rosa Luigia", 300 hectares of poplar is growing, certified under the FSC Standard: according to Indicator 6.5.5, the farm is required to retain 10% of the surface as a "representative area", restoring close-to-nature ecosystems. After a participatory approach led by expert consultants, the farm and the Park Authority signed a 5-year agreement in which the farm commits to carrying out specific interventions in natural areas owned by the Regional Park to fulfil the requirement. This solution is win-win and transforms a compliance requirement into an opportunity, where a public-private partnership led to reduction of costs for both partners, and more functional restoration. It also represents the first Payment for Ecosystem Services officially signed between a Park and an FSC-certified farm in Italy. Upscaling the scheme implies expanding the number of certified poplar farms in the area that would fulfill the FSC standard requirements in the Park. The scheme was launched with a grant from the Cariplo Foundation and this partnership is now used as a best practice in many EU projects such as Gestire 2020, an integrated LIFE project by Lombardy Region, and Sincere, a Horizon 2020 project.

**Keywords:** PES, poplar, FSC certification, nature-based solutions, green infrastructures

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## **BioChar and BioSyngas: valuable tools to create a positive feedback loop of organics management to benefit Urban Forestry.**

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Small-scale gasification of biomass offers a tool to activate a local bioeconomy loop that can not only sustain but also enhance Urban Forestry projects. Projects that opens to the idea of a resilient urbanism that through innovative landscape infrastructure defines new perspective for a network city built on a high permeability of the environmental systems being able to regenerate abandoned spaces or forgotten voids. It's the idea of landscape-city, a continuum that melts together spaces of life with spaces of work around a great project of open spaces. A project revealing the potentiality of different territories, capable of transforming site specific weakness into peculiarity, able to work with geography, hydrography, topography of soil in a new empathy with nature. Residual biomass from Urban Forestry, if not handled correctly can pose serious economical and environmental hazards such as wildfires and baseline emissions (via natural decomposition \degradation processes). Small-scale gasification of the excess biomass produced by Urban Forestry provides for a double stream of value generation: BioEnergy in the form of BioSyngas and Biochar a stable organic matter that can be used to support and enhance the agricultural and forestry effort in a positive loop feedback that offers several positive benefits such as extended life and health of urban trees, storm water management in the form of flood control and immobilization of pollutants, and carbon sequestration. The presentation will provide a quantitative approach to the urbanistic, economical and environmental dimensions of residual urban biomass handling and conversion into valuable services.

**Keywords:** BioEconomy, Biochar, Biosyngas, NegativeEmissionTechnology, CO2Sequestration

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## How to measure urban forest performances

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Urban forests generate several benefits like flood reduction, food security, air quality improvement, urban heat island effect attenuation and energy consumption reduction, contributing to climate change adaptation/mitigation and urban resilience. It is necessary to assess the multiple benefits generated from urban green systems to recognise their full impact and to define policies and measures suitable for conservation and enhancement. An urban ecosystem is a dynamic system. Therefore, regular monitoring through the use of measurable indicators is needed. A system of indicators based on the ecosystem services will be able to catch all benefits and co-benefits generated. This paper presents a conceptual framework based on the ecosystem services approach to develop a set of KPIs for the assessment of urban forests. Several initiatives to evaluate green systems performances are analysed, including comprehensive approaches (MAES Urban), European awards (European Green Capital Award, Green Leaf Award), ISO standards (ISO 37120 on smart and sustainable cities, ISO 37121 on resilient cities). Moreover the global framework provided by the SDGs and the Aichi biodiversity targets is considered. More than 1000 indicators are reviewed at this purpose. Based on such screening and through the involvement of several cities participating at H2020 project Urban GreenUP, a set of KPIs to evaluate impacts and co-benefits generated by green systems is built. The indicators have been classified based on: i) challenges that cities have to face, ii) ecosystem services provided and iii) the scale of impact. 153 KPIs have been selected. The proposed set of indicators allows to take into consideration several dimensions of environmental, economic and social nature and it can be customised in order to follow specific research and policy aims. This integrated framework may then be applied to develop a composite indicator-based assessment model to measure and monitor performances of urban green systems in cities.

**Keywords:** urban green system, performance evaluation, ecosystem services, KPIs, urban resilience

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## **Conservation of veteran trees within historical gardens (COVE): a case study applied to *Platanus orientalis* L. in central Italy (Poster session)**

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Veteran trees characterize the landscape of Mediterranean historical parks and gardens, representing unique values from ecological, cultural, social and historical point of view. The absence of natural regeneration represents one of the main limits for their conservation. The main purpose of this research was to combine theoretical reasoning and practical solutions to preserve this rich tree heritage facing both ageing process and climate changes. A protocol based on an interdisciplinary approach was developed and applied at the plane trees within the formal garden of Villa Lante of Bagnaia (Viterbo, Italy), chosen as a case study. The analysis consists of the following four phases: i) selection of veteran tree species after gathering and comparing historical information; ii) taxonomic identification based on morphological and molecular analyses; iii) tree inventory in GIS environment; iv) vegetative propagation by woody cuttings and micropropagation. The plane trees surveyed grow on three level terraces and they significantly differ in size and phytosanitary conditions according to their topographic position. Molecular analyses indicated a genetic uniformity for the plane trees studied and their memberships to *P. orientalis* species. This evidence suggests that all specimens belong to the original planting dating back to 1576. All individuals showed a high susceptibility to *Ceratocystis platani* even though so far there is no evidence of canker stain attack. Woody cuttings from the most vigorous individual showed till 80% rooting rates. In vitro micropropagation by using node culture approach provided healthy plants, maintaining the genetic fidelity respect to mother plant after three years of culture. Both propagation methods can be used to produce new plants to replace damaged or risky specimens, or to preserve historical germoplasm by means of ex-situ collections. The obtained results represent a successful example of integrated research for germplasm conservation and management of veteran trees within historical villas, in central Italy.

**Keywords:** Conservation and management of Renaissance gardens; Phenotypic, morphological and molecular characterization; *Platanus orientalis* L.; Vegetative propagation

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